31st Annual Rehabilitation
in Multiple Sclerosis Conference

Abstract Book

Recovery and Compensation in Multiple Sclerosis Rehabilitation:
Rethinking Mechanisms, Decisions, and Outcomes

RiMS

31ST ANNUAL REHABILITATION IN MULTIPLE SCLEROSIS CONFERENCE

RECOVERY AND COMPENSATION IN MULTIPLE SCLEROSIS REHABILITATION:

Rethinking Mechanisms, Decisions, and Outcomes

June 11-13, 2026, Prague, Czech Republic

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CONFERENCE RATIONALE

Multiple sclerosis rehabilitation increasingly requires explicit choices between strategies that aim to restore function (recovery) and strategies that optimize performance through adaptation (compensation).

These are not competing philosophies but clinically meaningful options whose relative value depends on disease stage, functional reserve, goals, context, and available technologies.

The 2026 RiMS program connects biological mechanisms (neuroplasticity and reserve) to intervention design, precision decision-making, and outcomes that matter to people with multiple sclerosis, especially participation, autonomy, and quality of life.

By integrating multidisciplinary perspectives (medicine, therapy professions, psychology/neuropsychology, engineering, and outcomes research), the conference aims to advance implementable, evidence-based rehabilitation pathways that align with European priorities in digital health, real-world outcomes, and personalized care.

Measuring Recovery, Compensation, and Progression, Including Biomarkers, in Multiple Sclerosis and Related Disorders

Recovery, compensation, and progression follow different trajectories—improvement, adaptation, and often hidden decline—and each asks for its own way of being measured. The measure we choose can confirm what we observe, support our treatment, and guide our conversation with the person in front of us. This chapter explores this challenge across clinical, digital, and people-centered perspectives and shows how thoughtful measurement reshapes everyday rehabilitation.

5. Swimming Exercise Modulates Proinflammatory Cytokines in a Mouse Model of Multiple Sclerosis

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Abstract

Brain inflammation, particularly elevated cytokines such as tumor necrosis factor α (TNF-α) and IL-1β, plays a key role in the onset and progression of multiple sclerosis (MS). Exercise is recognized as a safe, natural method to support brain health and reduce inflammation in MS. This study examined the effect of 4 weeks of moderate swimming exercise on inflammatory cytokines (TNF-α and IL-1β) and fatigue- and motivation-related behaviors in female C57BL/6 mice with experimental autoimmune encephalomyelitis (EAE), an established model of MS. Twenty-one female mice were assigned to 3 groups: healthy control (HC) (n = 7), EAE control (n = 7), and EAE and swimming exercise (EAE+EX) (n = 7). EAE was induced with the MOG35-55 peptide. The EAE+EX swam for 30 minutes per day, 5 days a week, for 4 weeks. After training, brain tissue was collected to measure TNF-α and IL-1β via Western blot. The open field test (OFT) and sucrose preference test (SPT) assessed locomotor- and motivation-related behaviors.

EAE significantly increased TNF-α and IL-1β vs HC ($P < .05$). Swimming reduced both cytokines and improved movement and exploration in the OFT ($P < .05$), but not SPT performance. Four weeks of moderate swimming reduced brain inflammation and improved locomotor behavior in EAE mice, suggesting swimming as a safe complementary strategy for managing MS-related inflammation and fatigue.

8. Brain Activation During Motor-Cognitive Navigated Walking in People With Multiple Sclerosis in Comparison With Healthy Controls

Andreas Wallin,[1,2] Alexander Kvist,[1] Lucian Bezuidenhout,[1,3] Sverker Johansson,[1,2] Erika Franzén[1,2,4]

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Abstract

BACKGROUND: Neurological impairment in people with multiple sclerosis (PwMS) compromises motor-cognitive activity performance, but the underlying mechanisms and neural correlates remain poorly understood.

OBJECTIVE: To explore motor-cognitive performance and corresponding brain activation during motor-cognitive navigated walking in PwMS in comparison with healthy controls (HC).

METHODS: Thirty-eight PwMS (66% women; mean age 54 years) and 39 matched HCs were included. The motor task navigated walking was measured using wearable sensors and tracked in the number of navigation errors and hesitations. A cognitive-task auditory Stroop was measured in response time and accuracy. In the complex condition, 2 tasks were performed simultaneously. Functional near-infrared spectroscopy was used to measure brain activation over prefrontal areas. Effect of change, from separately to simultaneously performed tasks, was calculated and reported as a percentage for the motor and cognitive measures (complex effect).

RESULTS: For both groups during the complex condition, navigated walking speed was slower (complex effect PwMS = –3.6%; HC = –1.4%), response time was longer (complex effect PwMS = 7.6%; HC = 4.5), and there were more navigation errors and hesitations (PwMS = 10.5%; HC = 2.6%). PwMS walked more slowly, had longer response times, and made more navigation errors and hesitations during both the separate and complex conditions compared with HCs. HCs increased brain activation in Brodmann Area 46 during the complex condition ($P < .001$), but PwMS did not.

CONCLUSIONS: Complex walking had an effect on both motor and cognitive task performance for both groups, although the effect for PwMS was almost twice as large. This might be due to an inability to recruit or compensate with prefrontal activation. Future research should explore at what workload level PwMS reach this brain activation plateau.

15. Observational Gait Analysis Tools in Multiple Sclerosis: A COSMIN Meta-Analysis for Psychometric Properties

Mohammad Etoom

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Abstract

INTRODUCTION: Observational gait analysis (OGA) tools are widely used due to their simplicity, low cost, and feasibility. However, the psychometric properties of OGA tools remain unclear.

OBJECTIVE: To conduct a systematic review and meta-analysis investigating psychometric properties of OGA tools in multiple sclerosis.

METHODS: Consensus-Based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines were followed. COSMIN psychometric properties involve validity (content, structural, criterion, cross-cultural, and construct), reliability (internal consistency, reliability, and measurement error), and responsiveness. The measurement property will be rated as sufficient (+), insufficient (–), or indeterminate (?) using the COSMIN criteria for good measurement properties. The recommendations for scales were mainly based on content validity and internal consistency.

RESULTS: There were 5 included articles involving 3 OGA tools: Gait Assessment and Intervention Tool (G.A.I.T.), Tinetti Gait Scale (TGS), and Rivermead Visual Gait Assessment (RVGA). Structural validity, internal consistency, and measurement invariance were not evaluated in any of the included scales. G.A.I.T. shows sufficient content validity, reliability, and construct validity, whereas measurement error and criterion validity were not sufficient. TGS showed sufficient content validity and insufficient construct validity. Finally, RVGA showed sufficient content validity and responsiveness. All included OGA have the potential for recommendation. TGS has the best potential.

CONCLUSIONS: No OGA tool is currently recommended due to the absence of evidence of unidimensionality and internal consistency. Further studies are required, especially those investigating structural validity and internal consistency.

17. Feasibility and Clinical Application of Wearable IMU Sensors to Assess Gait, Balance, and Fatigue in Multiple Sclerosis

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Abstract

Multiple sclerosis (MS) frequently results in fatigue as well as impairments in gait and balance, which affect functional mobility and quality of life. Wearable inertial measurement units (IMUs) provide an opportunity to objectively quantify these functions in clinical and research settings. This project aims to implement the Opal Mobility Lab to support clinical decision-making and advance research on digital biomarkers of mobility and fatigue in 2 phases: evaluating feasibility and implementation in a rehabilitation setting, and investigating the relationships between postural sway parameters, gait characteristics, and fatigue in people with MS (PwMS).

Phase 1 is a pragmatic mixed-methods pilot study including 20 PwMS and 6 to 10 therapists. Participants will undergo a single standardized assessment using 6 IMU sensors while performing a 6-Minute Walk Test, an instrumented Timed Up and Go Test, and a postural sway assessment. Questionnaires will assess usability and comfort. Qualitative data will be collected through semistructured interviews and analyzed using thematic analysis.

Phase 2 is an observational study including 60 to 80 PwMS. During a single assessment, sway- and gait sensor–derived parameters and fatigue measures will be obtained using the Modified Fatigue Impact Scale, Walking Fatigability Index, and Borg Rating of Perceived Exertion. The primary objective is to examine associations between sway parameters and gait characteristics, with secondary analyses exploring relationships with physical and perceived fatigue. Statistical analyses will include normality testing, correlation analyses, multivariate modeling, and subgroup analyses.

This project will allow more accurate, objective monitoring of MS symptoms and the optimization of personalized rehabilitation programs.

23. Intrahemispheric and Interhemispheric Connectivity and Clinical Worsening in Multiple Sclerosis

Francesco Romanò,[1,2,3] Silvia Zucchelli,[1] Elisabetta Pagani,[1] Paola Valsasina,[1] Paolo Preziosa,[1,4] Maria Assunta Rocca,[1,4] Massimo Filippi[4,5]

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ABSTRACT

INTRODUCTION: Brain connectivity is an important determinant of disability in multiple sclerosis (MS). It fluctuates across the disease course and can lead to network collapse, causing functional deficits. We investigated how changes in short- and long-range connectivity within the sensorimotor network (SMN) contribute to disability and worsening physical performance in MS.

METHODS: We studied 100 patients with MS and 89 healthy controls (HCs), who underwent 3.0-T MRI and clinical evaluation, including the Nine-Hole Peg Test (9-HPT), the Timed 25-Foot Walk Test (T25-FWT), and the Expanded Disability Status Scale (EDSS). Patients with MS were reassessed after 1 year. Clinical worsening was defined using the EDSS-Plus (ie, EDSS progression or ≥20% deterioration in 9-HPT or T25-FWT). Group comparisons between HC and MS and between stable/worsened patients with MS evaluated functional connectivity and structural connectivity (SC) of the SMN at intrahemispheric and interhemispheric levels.

RESULTS: Patients with MS presented low disability levels (median EDSS = 1.5) and had worse baseline motor performance ($P \leq .001$) compared with HCs. They showed reduced interhemispheric SMN SC ($P \leq .001$), whereas other connectivity measures did not differ. After 1 year, 36 patients were classified as worsened by EDSS-Plus. No baseline demographic or clinical differences emerged between stable and worsened patients. However, patients with worsening showed higher intrahemispheric SMN SC at baseline ($P = .013$), which significantly decreased at follow-up ($P = .006$). No differences were observed in other SMN connectivity measures.

CONCLUSIONS: SMN connectivity evolves nonlinearly in MS. Interhemispheric SC disruption appears early, whereas increased intrahemispheric connectivity may reflect compensatory reorganization and is associated with subsequent clinical worsening.

24. Structural Neural Correlates of Electronic Symbol Digit Modalities Test Performance in People With Multiple Sclerosis

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Abstract

BACKGROUND: Electronic Symbol Digit Modalities Test (SDMT) adaptations could improve diagnosis and monitoring of cognitive impairment in people with MS (PwMS). Associations with brain features (construct validity), however, lack extensive validation.

OBJECTIVE: To explore structural brain correlates of performance to digital cognitive testing in pwMS.

METHODS: Thirty pwMS underwent cognitive testing via a validated electronic SDMT (eSDMT) and the oral SDMT, as well as 3D T1-weighted and fluid-attenuated inversion recovery (FLAIR) brain MRI imaging with a 3T scanner. Brain volumetrics were obtained using icobrain ms v.5.17.1 (icometrix), a Conformité Européenne–marked software for automatic segmentation and quantification of brain structures. We computed robust Spearman correlations between the eSDMT and oral SDMT scores and lesion volumes or normalized brain volumetrics of cognition-related brain structures (whole-brain volume [WBV], cortical lobes, thalamus), adjusting for age and education and correcting for multiple comparisons (Bonferroni-Holm).

RESULTS: eSDMT scores correlated with WBV (r = .709; P = .005) and volumes of FLAIR-hyperintense lesions (r = –.654; P = .005), T1-hypointense lesions (r = –.634; P = .005), frontal cortex (r = .514; P = .007), parietal cortex (r = .569; P = .006), thalamus (r = .478; P = .018), and cerebrospinal fluid spaces (r = –.482; P = .009). Oral SDMT scores also correlated with WBV (r = .623; P = .006), volumes of FLAIR-hyperintense lesions (r = –.670; P = .006), T1-hypointense lesions (r = –.701; P = .005), and parietal cortex (r = .494; P = .023), but not frontal cortex (r = .266; P = .198), thalamus (r = .377; P = .056) or cerebrospinal fluid (r = .381; P = .144).

CONCLUSIONS: eSDMT performance is associated with cognition-related brain imaging biomarkers in PwMS, with potential superiority for detecting atrophy compared with the gold-standard oral SDMT. This supports its use for longitudinal monitoring of clinical and radiological progression, warranting longitudinal investigation.

26. Enhancing the Value of the Montreal Cognitive Assessment as a Screening Tool for Multiple Sclerosis–Related Cognitive Impairment

Michelangelo Dini,[1,2] Letizia Turchi,[1] Giulia Gamberini,[2] Alessandra Caporali,[2] Luca Chiveri,[2] Mariaemma Rodegher,[2] Letizia Leocani[1,2]

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Abstract

BACKGROUND: The Brief International Assessment of Cognition for Multiple Sclerosis (BICAMS) is the gold-standard cognitive screening tool for people with multiple sclerosis (PwMS). However, studies show that non–MS-specific screening tools, such as the Montreal Cognitive Assessment (MoCA), are used far more frequently in real-world clinical practice, even for PwMS.

OBJECTIVE: To improve the detection of MS-related cognitive impairment (CI) using the MoCA.

METHODS: At Casa di Cura Igea, Milan, Italy, between January 2023 and February 2026, 215 PwMS underwent a neuropsychological examination that included MoCA and BICAMS. MS-related CI was defined as 1+ BICAMS score less than 1.5 SD from the normative mean. First, we evaluated the MS-related CI classification accuracy of 3 MoCA cutoffs based on published Italian normative data. Then, we trained a machine learning (ML) pipeline with age, education, and MoCA score as predictors, and MS-related CI as binary outcome.

RESULTS: Our sample included predominantly female (n = 129, 60%) PwMS with a progressive diagnosis (n = 149, 69%), a mean ± SD age of 54.78 ± 9.75 years, a mean ± SD education of 13.79 ± 5.06 years, and a median (1st-3rd quartile) Expanded Disability Status Scale score of 6.5 (6-6.5). Seventy-two (33.5%) had MS-related CI. All 3 normative MoCA cutoffs showed extreme specificity (97%, 94%, 99%) and below-chance sensitivity (31%, 39%, 8%). ML-based predictions greatly improved sensitivity (68%) and maintained good specificity (80%).

CONCLUSIONS: All published Italian normative MoCA cutoffs demonstrated insufficient sensitivity to MS-related CI. This translates to numerous false negatives in everyday clinical practice, likely leading to therapeutic delays. Our ML pipeline, specifically trained on data from PwMS, enhances the value of MoCA as a screening tool for MS-related CI by enabling earlier detection of CI.

32. CYPRO–High-Intensity Cycling in Primary Progressive Multiple Sclerosis

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Abstract

Endurance training improves the health-related quality of life (HRQoL), symptoms, and performance of people with multiple sclerosis. High-intensity interval training (HIIT) induces superior effects compared to moderate-intensity continuous training (MCT). Generalizability to people with primary progressive MS (PwPPMS) remains unclear due to mixed MS phenotypes in existing studies. CYPRO evaluates the effects of HIIT compared with MCT in PwPPMS.

In this randomized controlled trial, 43 pwPPMS (Expanded Disability Status Scale score ≤6) completed volume-matched HIIT or MCT sessions on a bicycle-ergometer 3 times per week during their inpatient stay at the Valens clinic. The primary outcome was cardiorespiratory fitness (measured via peak oxygen uptake [$\dot{V}O_2$peak]. Secondary outcomes included peak power output, walking capacity, cognitive performance, HRQoL, fatigue, anxiety, depressive symptoms, and blood-derived biomarkers. Outcomes were measured at baseline and discharge 3 weeks. End points were analyzed using a baseline-adjusted analysis of covariance.

A significant time×group effect was observed for $\dot{V}O_2$peak (P = .002; 95% CI, 0.46-1.82) with greater values in the HIIT group than in the MCT group. There were significant main effects of time for peak power output (P = .008; 95% CI, 6.38-16.25), walking capacity (P = .002; 95% CI, 38.06-69.01), cognitive performance (Verbal Learning and Memory Test, P = .023; 95% CI, –3.84 to 0.90), HRQoL (P = .003; 95% CI, –10.00 to –4.901). The analysis of the blood-derived biomarkers is still outstanding. There were no (serious) adverse events. Training adherence was 93.69%.

HIIT is more effective for improving cardiorespiratory fitness, but not superior to MCT for secondary outcomes. HIIT is safe and feasible in PwPPMS. These results provide recommendations for designing endurance training programs for PwPPMS that can be easily translated into clinical practice.

35. Psychometric Properties of 31 Assessment Tools for Multiple Sclerosis: What Works, What Doesn't, and What Captures Change

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Abstract

BACKGROUND: Assessment of people with multiple sclerosis (MS) requires tools covering diverse aspects of functioning. Clinicians face a vast array of instruments with limited guidance on how they relate to one another and which ones capture meaningful change.

OBJECTIVES: To evaluate the psychometric properties of 31 assessment tools used in MS rehabilitation, validate their linkage to the International Classification of Functioning, Disability and Health (ICF) Core Set for MS, and assess the utility of the ICF categorical profile.

METHODS: Twenty-eight tools were administered to 128 people with MS at 4 time points around a 2-month physiotherapy intervention (data set A): test-retest reliability, internal consistency, validity (concurrent, divergent, predictive for Expanded Disability Status Scale [EDSS] score, and falls), and responsiveness (standard error of measurement, minimal detectable change, minimal important difference) were assessed. Eight tools were evaluated in 29 people with MS (data set B) alongside the ICF categorical profile assessment.

RESULTS: Cluster analysis revealed 2 principal instrument groups, further divided into 2 blocks: mobility measures (objective/capacity vs subjective/performance) and quality-of-life measures (physical vs psychological domains). Two tools previously rated as having insufficient evidence by the MS Task Force, the 2-Minute Walk Test and the 5 Times Sit-to-Stand Test (5XSTS), demonstrated good to excellent reliability and validity; the 5XSTS emerged as the best fall predictor. Patient-reported outcomes (Multiple Sclerosis Impact Scale-29 [MSIS-29], Activities-specific Balance Confidence scale, EuroQoL 5-Dimension 5-Level questionnaire) captured therapy-related improvements not detected by objective tests. Notably, the MSIS-29 correlated with nearly all ICF Core Set categories, covering aspects that the EDSS overlooked. The ICF categorical profile proved useful for validating tools and for identifying commonly overlooked impairments.

CONCLUSIONS: Psychometric evaluation combined with ICF linking enables evidence-based, goal-oriented tool selection. Subjective instruments deserve equal standing alongside objective tests.

44. Linking Rehabilitation and Molecular Signatures: Long Noncoding RNA Changes in Patients With Multiple Sclerosis Undergoing Virtual Reality–Supported Therapy

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Abstract

Multiple sclerosis (MS) is a chronic autoimmune disease of the central nervous system that often leads to progressive neurological deficits and a reduced quality of life for patients. An integral part of comprehensive treatment is physical therapy, the effectiveness of which can potentially be enhanced using modern technologies such as virtual reality (VR), which supports patient adherence and enables personalized training.

Long noncoding RNAs (lncRNAs) represent a significant regulatory component of gene expression at the epigenetic, transcriptional, and posttranscriptional levels. Their dysregulation has been described in a number of pathological conditions, including MS, and changes in their expression are detectable in peripheral blood, making them promising noninvasive biomarkers.

In this study, we analyzed the expression of selected lncRNAs in the peripheral blood of patients with MS in relation to physical therapy intervention, including a variant utilizing VR. The study included 30 patients, some of whom underwent therapy supplemented with VR (n = 15). Candidate lncRNAs were selected based on current literature, and their expression was assessed using quantitative PCR.

Our findings indicate that physical therapy is associated with measurable changes in lncRNA expression profiles. These results support the role of lncRNAs as potential biomarkers of rehabilitation response. This work highlights the potential for combining molecular profiling with innovative rehabilitation strategies to advance personalized care in MS.

45. Physiotherapy-Induced Functional and Immunological Changes in People With Multiple Sclerosis: Benefits of Virtual Reality Integration

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Abstract

BACKGROUND: Multiple sclerosis (MS) is a chronic neurological disorder causing motor, sensory, and visual impairments that reduce functional independence. Physiotherapy is essential in MS management, aiming to improve mobility, coordination, and quality of life. Integrating virtual reality (VR) into rehabilitation may enhance training intensity, patient engagement, and neuroplasticity. Beyond functional benefits, physiotherapy can also induce systemic biological changes. This study compared conventional physiotherapy (PT) with VR-enhanced physiotherapy (PTVR) in people with MS (PwMS), examining selected immune parameters as objective markers of physiological response.

METHODS: Twenty-six PwMS were randomly assigned to PT (n = 13) or PTVR (n = 13). Peripheral blood samples were collected before and after the rehabilitation program to assess major leukocyte subsets, including T cells, B cells, natural killer cells, and monocytes. Monocyte differentiation into monocyte-derived dendritic cells was evaluated, and the potential effect of the HLA-DRB1*15 allele on therapy response was analyzed. Healthy controls (n = 8) were included for baseline comparison.

RESULTS: Both PT and PTVR increased T-cell proportions, with greater changes in the PTVR group. Baseline Treg cells (CD4+CD127−CD25+) were lower in PwMS than controls (P = .047), but differences were no longer significant after therapy (P = .156). No outcomes were associated with HLA-DRB1*15 status.

CONCLUSIONSS: Physiotherapy in PwMS elicits both functional and systemic responses. VR-enhanced therapy may amplify these effects, highlighting its potential for increasing overall physiological impact. Monitoring immune markers provides insight into patient responses and may guide optimization of physiotherapy strategies in neurological rehabilitation.

46. Smart NHPT for Motor and Cognitive Profiling in Multiple Sclerosis

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Abstract

Multiple sclerosis (MS) often impairs fine motor skills, highlighting the need for objective and sensitive assessment methods. This study introduces the Smart NHPT (www.smart-nhpt.com), an enhanced version of the 9-Hole Peg Test that integrates automated peg detection and video-based hand motion capture. In addition to total task duration, assembly and disassembly times and peg-level timing are recorded. Video analysis quantifies the hand's kinematic parameters, including spatial motion patterns, movement efficiency, speed, acceleration, jerk, pauses, variability, and interfinger coordination. The study involved 162 patients with MS; for each, average kinematic features across valid trials were computed, and highly collinear variables were removed. Experimental analysis examined performance differences across subgroups defined by disability (Expanded Disability Status Scale [EDSS]) and cognitive status (CogEval [Biogen]). Analysis of variance and post hoc Tukey tests revealed significant differences in execution times, with assembly time showing greater sensitivity to subgroup differences than total or disassembly time. Hence, performing the assembly phase alone could reduce patient burden without compromising the test's sensitivity. Associations between kinematic parameters and clinical scores were evaluated using ordinal logistic (EDSS) and linear regression (CogEval), adjusted for age and sex, alongside Spearman correlations. Higher disability levels were strongly associated with longer execution times and altered thumb movement patterns, particularly increased linearity and reduced jerk, indicating slower and more rigid motion. Cognitive performance was primarily linked to execution speed, with better outcomes observed in faster, smoother, and less interrupted movements. Overall, the Smart NHPT provides a noninvasive, cost-effective, and scalable tool for detailed motor assessment, offering valuable insights into both motor and cognitive aspects of MS-related status.

49. Impact of Information Processing Speed on Episodic Memory in Multiple Sclerosis: Insights From Survival Analysis

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Abstract

In multiple sclerosis (MS), poor performance on episodic memory tests is often difficult to interpret, as standard time-limited measures may confound memory deficits with slowed information processing speed (IPS).

[Our objective is t]o provide a clinically meaningful characterization of episodic memory by examining learning efficiency over time and its relationship with IPS in people with MS (PwMS).

A total of 157 pwMS and 109 healthy controls completed the Selective Reminding Test (SRT). Survival analysis was used to estimate the number of trials required to achieve 2 consecutive full recalls (SRT-goal), allowing the assessment of learning progression rather than time-constrained performance.

PwMS required significantly more trials than controls to reach the SRT-goal (10.23 vs 8.52 trials; $P < .001$). IPS played a critical role: PwMS with preserved IPS demonstrated more efficient learning (median = 9.71 trials), whereas those with impaired IPS showed slower acquisition (mean = 10.67 trials; $P < .001$). Clinically, only 12.5% of IPS-impaired PwMS reached the learning criterion, compared with 60% of those with preserved IPS. Marked differences were also observed across disease subtypes, with substantially lower success rates in progressive forms (secondary progressive MS: 15.8%; primary progressive MS: 15%) compared with relapsing-remitting MS (60%).

These findings highlight that slowed learning, rather than pure memory failure, contributes substantially to episodic memory difficulties in MS. Survival analysis provides a clinically relevant tool to disentangle these mechanisms and may guide individualized cognitive rehabilitation, particularly by targeting processing speed to improve learning outcomes.

50. Depression Screening in Multiple Sclerosis Rehabilitation: Comparing BDI-II and BDI-FS for Clinically Relevant Assessment

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Abstract

Depressive symptoms are common in people with multiple sclerosis (PwMS) and may affect engagement, adjustment, and outcomes in rehabilitation. However, their assessment is challenging because several somatic symptoms of depression overlap with MS-related symptoms such as fatigue, sleep disturbance, and cognitive complaints. This study compared depression rates identified by the Beck Depression Inventory-II (BDI-II) and the Beck Depression Inventory-Fast Screen (BDI-FS) in pwMS and discussed the clinical relevance of tool selection in MS rehabilitation settings. Three hundred and thirty-one PwMS (70.8% women; mean age, 48.1 years; median Expanded Disability Status Scale score, 4) completed the BDI-II. BDI-FS scores were derived to distinguish depressive symptoms from symptoms potentially related to neurological disease. Depression prevalence was compared across both measures, together with score differences and agreement between classifications. Depression prevalence was significantly higher with the BDI-II than with the BDI-FS (54.1% vs 31.1%; $P < .001$). The OR was 2.61 ($P < .001$). Rescaled scores differed significantly between measures (Wilcoxon $P < .001$) with a large effect size ($rb = .927$). Agreement between the 2 classifications was only moderate to low ($\beta = 0.41$). These findings suggest that depression estimates in PwMS vary substantially depending on the screening tool used. In rehabilitation contexts, instruments including somatic items may overestimate depression and complicate clinical decision-making. Measures designed to reduce overlap with neurological symptoms, such as the BDI-FS, may provide a more clinically relevant basis for identifying patients who require psychological support within multidisciplinary MS rehabilitation.

51. Autonomic Stress Reactivity in Multiple Sclerosis: Implications for Emotional Functioning and Rehabilitation Assessment

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Abstract

People with multiple sclerosis (PwMS) frequently experience anxiety, depression, fatigue, and reduced quality of life, yet the physiological processes underlying emotional dysregulation remain poorly understood. Because autonomic stress reactivity may inform both assessment and individualized rehabilitation, this meta-analytic review examined whether PwMS show altered autonomic responses to emotional or psychological stress (such as changes in heart rate, heart rate variability, or blood pressure), compared with healthy controls.

Fourteen studies were included, assessing heart rate, heart rate variability, blood pressure, electrodermal activity, and pupil response during emotional or stress-inducing tasks; quantitative analyses focused on cardiovascular indices. Between-group meta-analysis ($k = 6$) showed a large reduction in stress-induced autonomic responses in PwMS ($d = -1.21$), indicating a blunted physiological profile relative to controls. Qualitative findings from electrodermal and pupillary measures converged with this interpretation. Within-group analysis in PwMS suggested that autonomic responses were not absent but attenuated and variable ($d = 0.71$, $P = .079$). Despite substantial heterogeneity across studies, the overall pattern supports blunted autonomic flexibility in MS during psychologically salient situations.

These findings are clinically relevant for rehabilitation because autonomic measures may complement self-report and clinical observation by providing objective indices of emotional and stress regulation. Ultimately, standardized autonomic assessment could help identify different stress-reactivity profiles, improve patient characterization, and support more individualized psychological or rehabilitation interventions in MS.

72. Tracking Physical Activity in Multiple Sclerosis: Accelerometer vs Self-Report Measures Across the Disability Spectrum

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Abstract

BACKGROUND: Physical activity (PA) provides health and rehabilitative benefits in multiple sclerosis (MS); however, accurate assessment across the disability spectrum remains challenging.

METHODS: This study employed self-reported measures (International Physical Activity Questionnaire–Short Form and the Physical Activity Scale for Individuals with Physical Disabilities) alongside the McRoberts MoveMonitor accelerometer to assess PA levels and intensity in 29 people with MS (PwMS) across varying disability levels, based on Expanded Disability Status Scale scores (range, 2.0-8.5). A 1-way analysis of variance was used to examine differences in mobility and sedentary behavior among 3 disability groups (mild, moderate, severe) and to compare self-reported vs objective measurements.

RESULTS: Both methods distinguished PA levels across disability groups (Cohen $\kappa = 0.740$). Significant between-group differences were observed in PA levels ($P < .001$, $\eta^2 = 0.561$) and energy expenditure (total metabolic equivalent of tasks per day, $P < .001$, $\eta^2 = 0.434$), particularly for moderate-to-vigorous activities. Average daily sitting time differed significantly ($P = .011$, $\eta^2 = 0.295$), whereas daytime lying did not ($P = .755$, $\eta^2 = 0.021$), suggesting the use of recovery strategies in more active PwMS. Participants with moderate-to-severe disability tended to overestimate moderate-to-vigorous activity in self-reports compared with accelerometer data.

CONCLUSIONS: Objective and self-reported measures reliably detect differences in PA levels across a disability spectrum. However, self-reports overestimate higher-intensity activity among individuals with a higher level of disability, indicating that questionnaire-based assessments should be used cautiously to avoid overestimating activity levels.

80. Aerobic Fitness and Fatigue-Related Measures Differentially Relate to Motor Cortex Excitability and Inhibition in People With Multiple Sclerosis and Mild Disability: A TMS Study

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Abstract

This study investigates mechanisms underlying perceived fatigue and fatigability in people with multiple sclerosis (PwMS), such as aerobic capacity and corticospinal function. As PwMS often show reduced cardiorespiratory fitness (VO2max), we examined exercise-induced changes in motor cortex excitatory and inhibitory processes during exhaustion and the differential contribution of reported fatigue-related measures.

Twenty PwMS (age = 42.95 ± 8.21 years; Expanded Disability Status Scale = 2.0 ± 0.94) and 20 healthy controls (HC) performed the 6-Minute Walk Test (6MWT) and fatigue (Visual Analog Scale [VAS]), fatigability (Pittsburgh Fatigability Scale [PFS]), and fatigue impact (Modified Fatigue Impact Scale [MFIS]) assessments. Cortical excitability and inhibition were evaluated pre-to-post maximal cardiopulmonary exercise test (CPET) using transcranial magnetic stimulation to build the motor evoked potential recruitment curve (Slope_MEP) and contralateral silent period (cSP) at 105% to 155% of the active motor threshold (AMT) during a 10% maximal voluntary contraction of the first dorsal interosseus.

PwMS showed lower 6MWT and VO_2max, and higher VAS, PFS physical, and MFIS than HC ($P < .05$). In PwMS, 6MWT negatively correlated with MFIS total, MFIS physical, PFS physical, and PFS mental, but not with VAS. Slope_MEP also negatively correlated with MFIS physical and PFS physical.

Following CPET, HC showed decreased Slope_MEP and AMT, whereas PwMS showed no changes.

In PwMS, hierarchical regression analyses showed that VO_2max predicted Slope_MEP ($R^2 = 0.30$), with no added effect of fatigue-related measures. VO_2max did not predict cSP duration, but adding MFIS physical explained an additional 25.1% of variance.

Corticospinal excitability may represent a neurophysiological biomarker of physical fatigability in PwMS and mild disability. Aerobic fitness influences motor excitability, whereas cortical inhibition relates closely to daily fatigue impact.

100. Chair Rise Muscle Power in Multiple Sclerosis: Implications of Disability Status and Sex

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Abstract

Muscle power (ie, rate of work performed) has emerged as a key clinical factor in both healthy older adults and people with multiple sclerosis (PwMS). The 5-times sit-to-stand muscle power test (5STS_power) is a simple and widely used chair-rise test. In this exploratory cross-sectional study, we aimed to (1) compare 5STS_power between PwMS and healthy controls (HC) and (2) examine the effects of disability status and sex on 5STS_power.

Body weight–normalized 5STS_power was estimated using the time to complete the test, together with body height and chair height. Between-group differences were analyzed using linear mixed-effects models. Disability status subgroups were based on either the Expanded Disability Status Scale or the Patient-Determined Disease Steps.

A total of 611 PwMS (67% female) and 147 HC (54% female) were analyzed. Compared with HC (5.55 ± 1.41 W/kg), 5STS_power was lower in PwMS (–1.75 [–1.99; –1.52] W/kg, –32%), with a stepwise decline across disability stages (no disability –13%, mild –26%, moderate –33%, severe –46%). Comparable differences were observed in both females (–1.71 [–2.02; –1.40] W/kg; –32%) and males (–1.73 [–2.11; –1.34] W/kg; –30%), also demonstrating a stepwise decline across disability stages (data not shown). In PwMS, men had slightly higher 5STS_power than women (0.28 [0.06; 0.50] W/kg, +8%), with the difference highest in the no-disability group (0.80 [0.06; 1.54] W/kg, +18%).

5STS_power was reduced in PwMS vs HC. Differences were evident even in the no-disability subgroup, supporting its role as a biomarker for functional capacity and suggesting the need for early rehabilitation.

104. Cortical Activity Mechanisms Underlying Walking Fatigability in People With Multiple Sclerosis: An fNIRS Study

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Abstract

INTRODUCTION: Walking fatigability significantly affects people with multiple sclerosis (PwMS) and may be caused by reduced neural capacity.

OBJECTIVE: To investigate the neural correlates of walking fatigability in PwMS during a 6-minute walk test (6MWT).

METHODS: Forty-two PwMS (Expanded Disability Status Scale 4.5 [3.5], 51 ± 11 years) and 25 healthy controls (HC, 52 ± 7 years) performed a 6MWT wearing inertial measurement units and a functional near-infrared spectroscopy (fNIRS) for gait and cortical activity measurement, respectively. Fatigability indices for gait speed (GS), foot-strike angle (FS) and step duration variability were calculated. fNIRS covered frontopolar (FPC), premotor (PMC), supplementary motor (SMA), and primary motor (M1) cortices. The relative (Δ between minutes 6 and 1) oxy (ΔHbO) and deoxyhemoglobin (ΔHHb) (for cortical activity changes) were correlated with fatigability indices using Spearman/Pearson.

RESULTS: In PwMS, GS index correlated weakly positively with ΔHbO in the dorsolateral prefrontal cortex (DLPFC) and SMA ($\rho < 0.329$, $P < .049$). Conversely, HCs exhibited moderate positive correlations between the GS index and the ΔHbO in the FPC ($r = 0.429$, $P = .036$) and negative correlations with ΔHHb across DLPFC, PMC, SMA, and M1 ($\rho < -0.437$, $P < .036$). HCs showed moderate negative correlations between the FS index and ΔHHb in the DLPFC, SMA, and PMC (rho < –0.496, $P < .016$). Increased cortical activity in the FPC (ΔHbO) was followed by increased SDV ($r > 0.351$, $P < .046$) in both groups.

CONCLUSIONS: Reduced walking fatigability is associated with increased cortical recruitment. Although HCs recruited a broader motor/cognitive network, PwMS rely on a more cognitive-driven network. However, increasing cortical activity to offset fatigability may increase gait variability, suggesting a functional trade-off.

106. A Novel Clinical Test to Detect Subtle Mobility Deficits in Mild Multiple Sclerosis: Measurement Properties of the Walking Adaptability Ladder Test

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Abstract

BACKGROUND: Walking adaptability is essential for community ambulation, yet few clinical tests assess it and often show ceiling-effect in high-functioning populations. The Walking Adaptability Ladder Test (WALT) is a dynamic task requiring continuous foot-placement adaptation and may detect subtle deficits in persons with MS (PwMS) with low disability. This study evaluated its reliability and validity in PwMS.

METHODS: Fifty-one PwMS (Expanded Disability Status Scale score: 1.3 ± 1.1) and 21 age-matched healthy controls (HCs) were included. Participants performed single and double runs of the WALT during 2 sessions 7 days apart, with performances video recorded. Inter-rater and test-retest reliability were assessed using intraclass correlation coefficients (ICC). Construct validity was examined by comparing WALT scores between PwMS and HCs, and correlating them with the Mini Balance Evaluation Systems Test (Mini-BEST), Symbol Digit Modalities Test, 6-Spot Step Test (SSST), 6-Minute Walk (6MWT), Heel-Rise Test (HRT), Activities-Specific Balance Confidence (ABC), and MS-Walking Scale (MSWS-12).

RESULTS: The WALT showed excellent test-retest (ICC: 0.93-0.95 [95%CI, 0.89-0.97]) and inter-rater (ICC: 0.84-0.96) reliability. WALT scores were significantly higher in PwMS compared with HC (single-run 15.3 vs 11.8; double-run 28.1 vs 22.1). WALT was significantly associated with cognition (single-run $\rho = -0.44$ and double-run $\rho = -0.39$), patient-reported outcomes (MSWS-12: 0.44 and 0.31; ABC: −0.49 and −0.39), balance and mobility (SSST: 0.61 and 0.58; MiniBEST: −0.59 and −0.47; 6MWT: −0.69 and −0.55), and lower-limb strength (HRT: −0.61 and −0.55).

CONCLUSIONS: The WALT demonstrates strong reliability and validity and is sensitive to subtle walking impairments in PwMS with low disability. It shows stronger associations with clinical outcomes, particularly balance and walking capacity, supporting its potential for early detection of functional deficits.

111. Patient-Reported Measures in Multiple Sclerosis: A Network Analysis for Stratification and Outcomes Assessment

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Abstract

Patient-reported and clinically assessed outcomes provide essential insight into the lived experience of people with multiple sclerosis (PwMS). Examining how these measures interact across domains may help clarify whether they capture overlapping or distinct aspects of the disease experience, improving their use in treatment evaluation and personalized rehabilitation.

We explored the relationships among the physical, cognitive, and emotional domains using a network-based approach in a cohort of 1176 PwMS. The amount of shared information between variables was quantified by predicting each item from all the others (least absolute shrinkage and selection operator regression), allowing for the identification of the most relevant cross-domain associations.

The final cohort comprised 961 PwMS (age = 54.0 ± 2.5; 628 women; disease duration = 14.4 ± 10.2 years). Four connected components (CCs) emerged: cognition, physical function, bladder function, and mood. Notably, factors derived from the Modified Fatigue Impact Scale (MFIS), which assesses the perceived impact of fatigue, were entirely embedded within the mood-related CC, highlighting a close link between fatigue and mood. Moreover, MFIS showed a participation coefficient of 0, indicating minimal contribution to information exchange across different CCs. In contrast, higher participation coefficients were observed for cognitive and functional-level factors, derived from the Montreal Cognitive Assessment (0.44-0.46) and the Functional Independence Measure (up to 0.499), respectively, reflecting greater contribution to interdomain information exchange.

This suggests that the burden of fatigue impact may be more closely related to emotional factors than to physical or cognitive disability, while cognition and independence play a central integrative role across domains.

128. Establishing Reliable Change Indices for Cognitive and Motor Screening in Multiple Sclerosis: Implications for Clinical Practice

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Abstract

BACKGROUND: Multiple sclerosis (MS) is a heterogeneous disease with highly variable symptoms. While modern treatments have reduced relapse frequency, persistent disease activity, as evidenced by progression independent of relapse activity, demands robust monitoring and evidence-based evaluation of cognitive and motor function. This study aims to establish reliable change indices for key MS screening measures to improve the detection of clinically meaningful change.

METHODS: We conducted a 4-year longitudinal study in a healthy population (N=102; mean age 37.1 ± 10.5 years; mean education 17.1 ± 3.0 years; 64.7% female), demographically matched to the MS center at the Prague General University Hospital. Participants completed annual assessments using the Brief International Cognitive Assessment for MS, Paced Auditory Serial Addition Test, Timed 25-Foot Walk Test, 2-Minute-Walk Test (2MWT), and 9-Hole Peg Test at baseline, 12, 36, and 48 months to define normative performance trajectories for these tools.

RESULTS: Group-level analysis revealed a learning effect in cognitive measures, with Symbol Digit Modalities Test (SDMT) scores increasing from baseline (M=62.6 ± 9.1) to month 48 (M=66.9 ± 9.4). Motor measures, including the 2MWT, showed relative stability (baseline M= 223.7 ± 29.4, month 48 M=229.1 ± 32.4). However, individual performance varied widely, with annual SDMT changes ranging from +22 to −19 points and 2MWT changes from +93 to −77 meters.

CONCLUSIONS: These findings highlight the necessity of reliable longitudinal normative data to differentiate true change from natural variability in MS screening. Using our dataset, we will calculate reliable change indices and develop regression-based models to enhance the evaluation of cognitive and motor trajectories in MS, supporting more accurate assessments.

130. Are Versions of the 12-Item Multiple Sclerosis Walking Scale Structurally Valid? A COSMIN Systematic Review

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Abstract

BACKGROUND: The 12-Item Multiple Sclerosis Walking Scale (MSWS-12), measuring walking difficulty, was developed in English. It is widely used and has been translated into multiple languages. According to recommendations from Consensus-Based Standards for the Selection of Health Measurement Instruments (COSMIN), each translated version should be psychometrically evaluated as a separate scale.

OBJECTIVE: To assess the structural validity of versions of the MSWS-12.

METHODS: Following COSMIN guidelines, a systematic review of studies assessing the structural validity of the MSWS-12 using classical test theory and/or item response theory was conducted. Structural validity was rated as sufficient (+), insufficient (–), or indeterminate (?).

RESULTS: A total of 9 studies were identified for the English, Dutch, Italian, Croatian, and Persian versions. The English, Dutch, and Croatian versions demonstrated sufficient structural validity, whereas the Italian and Persian versions did not. The English version showed strong unidimensionality (comparative fit index [CFI]=0.99; standardized root mean residual [SRMR]=0.04; factor loadings 0.62-0.93; explained variance 66% to 80%) with no cross-loadings. The Dutch version showed excellent fit (CFI=1, SRMR=0.02). The Croatian version showed high factor loading (0.81-0.95), an explained variance of 81.2%, and no cross-loadings. Insufficiency in the Italian version was due to a violation of local independence (residual correlation<0.2), and in the Persian version, it was due to excessive cross-loadings (>10%). All studies were of very good or adequate quality, except the Persian study, which was rated inadequate due to its low sample size.

CONCLUSIONS: Structural validity analysis is important for ensuring unidimensionality and validity of scoring criteria. Further high-quality studies are required for other versions.

132. Rehabilitation-Related Changes in Resting-State Functional Connectivity in People With Multiple Sclerosis: A Controlled Pre/Post fMRI Study

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Abstract

BACKGROUND: Multiple sclerosis (MS) is associated with widespread alterations in functional brain networks contributing to motor and cognitive impairments. Understanding how rehabilitation influences functional network organization may clarify the neural mechanisms underlying functional recovery.

OBJECTIVE: To investigate rehabilitation-related changes in resting-state functional connectivity and clinical outcomes.

METHODS: Participants with MS (n=18; mean age 48.11 ± 9.24; mean Expanded Disability Status Scale score: 3.63 ± 0.68) were allocated to a treatment group receiving a rehabilitation program or a control group. Resting-state fMRI data were obtained at baseline and after a 3-month intervention. Functional connectivity was analyzed using a region-of-interest to region-of-interest approach with the CONN toolbox (v22.a) and Statistical Parametric Mapping. Preprocessing included motion correction, normalization to Montreal Neurological Institute space, spatial smoothing, and CompCor-based noise reduction. Connectivity values were calculated using Fisher-transformed correlation coefficients and analyzed using a general linear model with group × time interaction, with false discovery rate (FDR) correction for multiple comparisons (p-FDR<0.05). Walking capacity and mobility were assessed using the 6-Minute Walk Test and Timed Up and Go Test.

RESULTS: Following the intervention, the treatment group demonstrated increased functional connectivity mainly within salience and frontoinsular networks. Increases were observed between the right inferior frontal gyrus and salience network regions, including the anterior cingulate cortex and anterior insula. Additional increases were detected in the insular and inferior frontal regions, as well as within cerebellar networks. No significant changes in connectivity were observed in the control group. Walking capacity and mobility improved.

CONCLUSIONSS: Rehabilitation may promote reorganization of functional brain networks in people with MS. Increased connectivity within salience and frontoinsular networks may reflect neuroplastic mechanisms underlying functional recovery.

Motor Recovery and Adaptive Compensation in Multiple Sclerosis and Related Disorders

Motor recovery refers to the restoration of original movement patterns through neuroplastic reorganization of the central nervous system, leading to improved quality, coordination, and efficiency of movement. In contrast, adaptive compensation involves using alternative strategies—such as recruiting different muscles or body segments—to achieve a functional goal without restoring the original motor pattern.

Rather than representing a strict dichotomy, recovery and compensation should be viewed as dynamic, interacting processes whose relative contributions may vary with disease stage, residual capacity, and individual patient characteristics.

This chapter focuses on approaches and strategies to facilitate motor recovery while appropriately addressing and managing compensatory mechanisms.

10. Mechanisms Underlying Exercise-Induced Pain Modulation in People With Multiple Sclerosis: A Scoping Review

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Abstract

BACKGROUND: Multiple sclerosis (MS) is a prevalent chronic neuroinflammatory disease characterized by demyelination, inflammation, and axonal degeneration. Up to 40% of people with MS (PwMS) experience central neuropathic pain (CNP). Despite numerous debilitating consequences, CNP is often underdiagnosed and undertreated, with limited pharmacological options available. However, exercise is a promising nonpharmacological intervention in the management of pain.

OBJECTIVES: This scoping review aims to (1) outline the pathophysiological mechanisms of CNP in MS, (2) summarize the neurophysiological effects of exercise on pain in MS, and (3) identify the mechanistic approaches through which exercise could modulate pain.

METHODS: PubMed, Embase, Web of Science, and SPORTDiscus were searched using terms related to MS, exercise, and pain modulation. Quantitative studies investigating effects or mechanisms of exercise on recurrent, subacute, or chronic pain in pwMS were included if pain was assessed through self-reported or objective measures.

RESULTS: Thirty-four articles were included. Methodological findings suggest that neuroinflammation, structural and functional changes in the central nervous system, and alterations in neurotransmitters and hormones contribute to pain in PwMS. Exercise was found to modulate several of these mechanisms, including inflammatory markers, neurostructural and functional brain changes, and pathways involving the endocannabinoid and tryptophan systems.

CONCLUSIONS: Exercise may exert beneficial effects on central mechanisms relevant to pain modulation in pwMS, including neuroinflammatory pathways, neuroplastic adaptations, and neurotransmitter regulation. However, existing evidence is limited, warranting further high-quality research to fully clarify mechanistic links and establish exercise as a targeted nonpharmacological treatment for CNP in PwMS.

11. Dynamic Adaptation Responses to Auditory Perturbations During Walking in Multiple Sclerosis With Progressive Subtypes

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Abstract

BACKGROUND: Walking demands adaptation to dynamic environments, yet how people with progressive multiple sclerosis (PwPMS) adapt movement timing during locomotion remains unclear. We thus investigated PwPMS's stepwise adaptation to controlled auditory perturbations, manipulating type, direction, and stimulus complexity, relative to healthy controls (HC).

METHODS: Twenty-one PwPMS and 18 HCs completed 2 randomized blocks (music, metronomes), each with four 3-minute walking trials: 2 phase perturbations (±90°shifts) and 2 period perturbations (±10% tempo-change). Each trial began with 30 seconds of steady 100-beats-per-minute walking, followed by 7 unpredictable perturbations in 23-second windows. Data were segmented into perturbation windows and fitted with cubic-B splines to extract peak response, time to peak, and response duration. Group differences were determined using 95% CIs using a nonparametric bootstrap method.

RESULTS: PwPMS detected perturbations and initiated adaptations, but didn't converge to the target tempo, undershooting relative to HCs. For positive perturbations, HCs overshot targets across conditions, whereas PwPMS undershot in both tempo and phase perturbations. For negative perturbations, group differences were evident for music, with PwPMS exhibiting greater response variability. PwPMS also demonstrated slower response dynamics in metronome conditions, while HCs reached the peak response faster. Total response duration was significantly longer in PwPMS, particularly for negative metronome and music perturbations, suggesting delayed recovery following perturbations.

CONCLUSIONSS: PwPMS perceived and initiated adaptation to auditory timing changes but exhibited incomplete and slower corrections, especially under inhibitory and complex conditions. These findings warrant the assessment of adaptive control during walking under temporally dynamic conditions, which is essential in daily living.

20. Complexity of Falls in People With Multiple Sclerosis

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Abstract

BACKGROUND: Individuals with multiple sclerosis (MS) have a markedly higher fall frequency than the general population, with recurrent falls reported by over one-third of people with MS. Fall-related risk factors span all International Classification of Functioning, Disability and Health (ICF) domains, yet less is known about how these factors interact in real-life fall situations. A deeper understanding of this complexity is essential for effective fall prevention.

OBJECTIVE: To explore and describe contributing factors and the multifaceted nature of fall situations among individuals with MS

METHODS: In this longitudinal study, 33 adults with MS who had fallen at least once in the past year and did not use walking aids were followed prospectively. Participants reported falls as they occurred, and brief follow-up interviews were conducted shortly thereafter. Descriptive statistics summarized fall frequency, timing, and location. A deductive content analysis, guided by the ICF framework, identified influencing and interacting factors.

RESULTS: Twenty-five participants reported 94 fall events. Most falls occurred during daytime (61%) and outdoors (56%). The analyses revealed that falls rarely resulted from a single factor. Instead, they reflected complex interactions between physical impairments, activity demands, environmental challenges, and personal factors, such as fatigue and fluctuating function.

CONCLUSIONS: This study demonstrates that fall situations in individuals with MS arise from multilayered interactions rather than isolated risk factors. Considering the contextual and dynamic nature of falls may enhance clinical conversations and improve the precision of fall risk assessments. Integrating individualized self-management–oriented strategies that address this complexity may help reduce fall incidence.

28. Comparison of the Blood Lactate Profile of Low and Moderately Fit People With Multiple Sclerosis With Healthy Controls

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Abstract

BACKGROUND: People with MS (PwMS) have displayed higher blood lactate concentrations at rest and lower lactate values during submaximal and maximal exercise intensities compared to healthy controls (HCs). Nonetheless, no study has thoroughly investigated the blood lactate profile of PwMS with various fitness levels. The aim of the present study was to examine and compare the lactate profile in PwMS across fitness levels and compare it with that of HCs.

METHODS: Twenty-three PwMS (16 women) and 8 HC (2 women) participated in this cross-sectional study. Participants performed a maximal aerobic capacity test ($\dot{V}O_2$-max test) used to categorize PwMS into "moderate-fitness" ($\dot{V}O_2$-max>26ml/kg/min) and "low-fitness" ($\dot{V}O_2$-max ≤ 26 ml/kg/min) groups. Individual lactate profiling tests were performed with at least 1 day of rest between tests. Maximal power output (W_{max}) derived from the $\dot{V}O_2$-max test was used to calculate a standardized workload for each participant.

RESULTS: No differences in lactate levels between groups at rest (P=.93) nor at any of the working intensities below 80% of W_{max} (P=.43) were found. Maximal lactate levels were approximately 22% and 29% higher in the moderate-fitness group (P=.01) and HC (P=.03), respectively, when compared to the low-fitness group. No difference was observed between the moderate-fitness group and HC (P=.63).

CONCLUSIONS: The blood lactate profile of PwMS did not differ from the lactate profile of HCs regardless of training status. However, a lower maximal lactate level was observed in low-fitness PwMS, suggesting reduced anaerobic potential compared with HC and moderate-fitness PwMS.

29. The Effect of Hippotherapy on Postural Control of the Trunk in Multiple Sclerosis: A Pilot Study

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Abstract

BACKGROUND: Multiple sclerosis (MS) may cause balance disorders, among several other symptoms. In hippotherapy, the horse's movement provides motor and sensory feedback to the equestrian and may therefore be a useful therapeutic strategy. The aim of this pilot study was to explore the short-term effects of hippotherapy on trunk balance in people with MS.

METHODS: Inpatients with MS and Expanded Disability Status Scale scores of 5 to 7 received hippotherapy individually (intervention group) or group balance training (control group). Both therapies consisted of 3 training sessions of 20 minutes each, once a week for 3 consecutive weeks, in addition to their standard rehabilitation program.

Trunk balance was assessed using the Trunk Impairment Scale (TIS) at baseline (T0) and at 3 weeks (T1). The Borg Rating of Perceived Exertion (RPE) scale measured effort and fatigue pre- and postsession.

RESULTS: Sixteen participants completed the study. At T1, TIS scores improved significantly for the hippotherapy group (n=11; P=.018), but not for the balance group (n=5, P=.066).

For the TIS subitems, no significant pre- or postsession differences were observed in either group. At T1, the hippotherapy group showed trends toward improvement in static sitting balance (P = .059) and coordination (P = .093); the control group showed trends in static (P = .066) and dynamic sitting balance (P = .066).

No changes were observed in Borg scores.

CONCLUSIONSS: Hippotherapy may be an effective therapy to improve trunk balance for people with MS, and sessions do not appear to induce fatigue. However, larger studies with longer follow-up are needed.

30. Impact of a Theoretical-Practical Program on Fatigue, Performance, and Quality of Life in People With Multiple Sclerosis

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Abstract

INTRODUCTION: Fatigue is one of the most frequent and disabling symptoms in multiple sclerosis (MS), with significant consequences for autonomy, social participation, and quality of life. Its multifactorial origin and the modest benefits of pharmacological treatments underscore the need for rehabilitation strategies. This quasiexperimental pilot study, approved by the relevant ethics committee (Ref.CEIM:123/2022), was designed to examine the effects of an intensive group program on perceived fatigue, functional performance, and quality of life in individuals with MS.

MATERIAL AND METHODS: Nine participants completed a 4-session intervention combining health education on fatigue identification and healthy lifestyle habits with occupational analysis and training in energy conservation strategies. Pre- and postintervention assessments included the Fatigue Severity Scale (FSS), Modified Fatigue Impact Scale (MFIS), visual analog scales for a chosen activity and for daily activities, and the European Quality of Life Dimension (EuroQOL-5). Effect sizes were calculated with Cohen *d*, and paired Student *t* tests were used to determine statistical significance.

RESULTS: The MFIS total score improved significantly, with the physical subscale showing the largest effect. Moderate improvements were noted in FSS scores, perceived ability to perform the chosen activity, and the impact of fatigue on basic tasks, though these differences were not statistically significant. Instrumental activities showed small changes, and quality-of-life scores exhibited a slight positive trend. Participants reported high satisfaction with the intervention.

CONCLUSIONSS: The program produced clinically meaningful improvements in fatigue impact—particularly in its physical dimension—and enhanced perceived functional capacity. These findings support the value of structured, group-based rehabilitation within interdisciplinary MS care.

38. How Motor and Cognitive Ability Affect Motor-Cognitive Performance in People With Multiple Sclerosis

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Abstract

INTRODUCTION: The ability to perform motor-cognitive tasks is essential for everyday life.

AIM: To compare motor-cognitive performance in people with multiple sclerosis (PwMS) and healthy controls (HCs), and to identify motor and cognitive factors associated with motor-cognitive performance.

METHODS: Participants completed a motor task (walking) and a cognitive task (auditory Stroop) in single- and dual-task conditions. Spatial and temporal gait parameters were measured using inertial sensors, and auditory Stroop response time was measured using audio recordings.

Within- and between-group differences were analyzed using *t* tests or Mann-Whitney *U* tests. Stepwise regression models examined association of motor (global balance: Mini-Balance Evaluation Systems Test; mobility: Timed Up and Go; step-time; step-time variability) and cognitive factors (task set shifting: Trail Making Test-IV; inhibition: Color-Word Interference Test-III; processing speed: Symbol Digit Modalities Test) with walking speed and response time during dual-task performance.

RESULTS: Thirty-seven PwMS (65% women; mean age 53.8 [SD, 12.2]); median Expanded Disability Status Scale score, 3.5 [IQR = 2.5-4.0]) and 39 HC (69% women; mean age 54.0 [SD, 11.6]) were included. During dual-tasking, PwMS walked slower (mean difference, 0.15m/s; 95% CI, –0.24 to –0.05; P = .003) and had longer response-time (mean difference = 0.20s; 95% CI, 0.19-0.28; P = < .001) than HC. In PwMS motor (global balance, mobility) and cognitive factors (processing speed, task set shifting, inhibition) significantly explained walking speed (ΔR^2_{motor} = 32%, $\Delta R^2_{cognitive}$ = 28%) and response time (ΔR^2_{motor} = 39%, $\Delta R^2_{cognitive}$ = 38%) while dual-tasking. In HCs, only motor factors, including step-time measures, significantly explained walking speed during dual-tasking (ΔR^2_{motor} = 55%).

CONCLUSIONS: Motor-cognitive performance was affected in PwMS compared with HCs. Both motor and cognitive factors captured by clinical measures significantly explained motor-cognitive performance in PwMS. For deeper understanding, studies exploring brain activation during motor-cognitive activities are warranted.

40. Investigating the Impact of Motor Fatigability on Cognition and Balance in People With Multiple Sclerosis

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Abstract

The effects of fatigability are still unclear because of a lack of a valid fatiguing task and a cognitive/motor assessment in multiple sclerosis (MS). The novelty of this study is to induce acute fatigability during a sustained walking test while concurrently assessing cognition and balance in a large sample of people with MS (PwMS). In this multicenter cross-sectional study, 150 participants were assessed before (PRE), immediately after (POST), and 30 minutes after (REST) a fatiguing walking test. Cognitive performance was assessed using the Brief International Cognitive Assessment for Multiple Sclerosis; static balance was evaluated through sway amplitude, and sample entropy was measured with inertial measurement units. Assessments were conducted before (PRE), immediately after (POST), and 30 minutes after (REST) the fatiguing task. PwMS were classified according to the Modified Fatigue Impact Scale (MFIS) into a high-fatigue group (MS_HF; MFIS ≥ 38 points) and a low-fatigue group (MS_LF; MFIS < 38 points). A total of 120 PwMS were included, along with 30 healthy controls (HCs). Cognitive scores showed a significant time × group interaction (P = .001). Medio-lateral sway amplitude increased across time points in MS_HF, showed smaller changes in MS_LF, and remained stable in HCs (P < .001). Medio-lateral sample entropy decreased across timepoints in MS_HF, indicating reduced postural control complexity, whereas MS_LF showed minor reductions and HCs showed no changes (P < .001). No significant changes were observed in the anteroposterior direction. Motor fatigability induces immediate impairments in cognition and medio-lateral postural control in PwMS, particularly in individuals with high trait fatigue. Fatigue-based stratification may inform more personalized rehabilitation strategies.

41. Brain Activity and Connectivity Are Increased in Fatigued People With Multiple Sclerosis During a Static Balance Task: A fNIRS Study

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Abstract

Fatigue and balance disorders are highly prevalent in people with multiple sclerosis (PwMS), yet the neural mechanisms underlying their interplay during functional postural control remain poorly understood. In this cross-sectional study, we investigated the relationship between fatigue, balance, and cortical hemodynamics and connectivity measured with functional near-infrared spectroscopy (fNIRS).

We recruited 16 PwMS (Expanded Disability Status Scale score < 3.5) and 19 healthy controls (HCs). Based on the Modified Fatigue Impact Scale (MFIS), PwMS were classified as fatigued (f_PwMS, MFIS ≥ 38; n = 10) or nonfatigued (nf_PwMS, MFIS < 38; n = 6). Participants performed static balance on foam with eyes closed while fNIRS was recorded over frontal, temporal, and occipital cortices. Outcomes, including MFIS, postural sway, hemodynamic response (HR; oxy-hemoglobin changes), were estimated using linear mixed-effects models, and interchannel functional connectivity computed via coherence analysis.

In PwMS, MFIS showed a trend toward association with sway (r = 0.49; P = .06). Sway was higher in f_PwMS than nf_PwMS and HCs, but group differences were not significant (*P* = .341). Compared with HCs, PwMS showed increased bilateral prefrontal HR (BA10) and reduced occipital HR (BA18). Stratified analyses indicated greater HR in f_PwMS vs HCs and nf_PwMS in bilateral BA10 and temporo-parietal regions (BA21-22; right BA39-40), with a right-hemisphere predominance; occipital differences (BA18,19) also emerged between MS subgroups. Global coherence did not significantly differ across groups; however, an exploratory BA10 analysis showed higher prefrontal coherence in f_PwMS than nf_PwMS (*P* = .02).

During a sensory-challenging stance, f_PwMS exhibit amplified right prefrontal and temporo-parietal activation and focal prefrontal hyperconnectivity, consistent with compensatory top-down control to maintain balance aimed at guiding biomarker-driven rehabilitation trials.

47. An Outpatient Rehabilitation Program for People With Multiple Sclerosis: A Pilot Study

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Abstract

BACKGROUND: People with multiple sclerosis (MS) have significant challenges in accessing specialized outpatient rehabilitation. There is still a need for evidence to establish nonpharmacological treatment as an important component of MS care. This pilot study evaluated a multidisciplinary outpatient program developed to address motor recovery, psychosocial well-being, and nutritional self-management in people with MS.

METHODS: Twenty-five participants (mean age, 50 years; 80% female; mean Expanded Disability Status Scale score, 4.3) were enrolled in a 4-month program including individual physiotherapy, group physiotherapy, supportive group psychotherapy, and nutritional recommendations. Twenty participants completed the full program and pre/post assessments. Six validated outcome measures were used to assess gait, fine motor skills, cognitive functions, balance confidence, and the impact of MS on daily life and fatigue. Paired *t* tests with multiple comparison correction were applied.

RESULTS: Statistically significant improvements were found in 8 of 10 outcomes after the 2-month intensive phase. The greatest effects were observed in gait coordination ($P < .001$), impact of MS on daily life ($P < .001$), balance confidence ($P = .018$), and fine motor function of the dominant hand ($P = .006$). No significant change was detected in fatigue or walking speed.

CONCLUSIONS: A structured, intensive, multidisciplinary program can yield clinical improvements in motor, cognitive, and quality-of-life aspects in people with MS. These findings can support implementation of this model as an essential component of standard MS care.

This project was realized with the financial support of the Ministry of Health of the Czech Republic. Reg. No. 025/CAU/PVP/043 / MZDR 26259/2024/CAU.

53. MS-ACT: A Concept for Severely Affected Patients With Multiple Sclerosis

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Abstract

BACKGROUND: Many severely affected people with multiple sclerosis (SA-PwMS) cannot perform basic tasks relevant to a self-determined life. The therapy options for SA-PwMS are limited. In advanced stages, they receive home-based therapy that focuses on passive interventions but underestimates their potential to maintain or regain some independence to various extents.

OBJECTIVE: In our rehabilitation center, a new multidisciplinary approach was developed based on the Bobath concept and the International Classification of Functioning, Disability, and Health model (ICF). The aim of MS-ACT is to complement physiotherapy and occupational therapy as a functional, resource-oriented intervention focused on empowering individuals to lead self-directed lives.

CONCEPT DESCRIPTION: In addition to their weekly sessions of physiotherapy and occupational therapy, the patients received 1 to 2 sessions of MS-ACT and activating nursing care. Patients' own home settings (ie, size of home, presence of stairs, lifts, floor conditions, thresholds, type of bed, disability aids in the bathroom) were contributing factors to the development of the therapy plan. Family support, physical state (ie, spasticity, pain, muscle weakness, Uhthoff phenomenon), and cognitive state were also considered.

CONCLUSIONSS: The MS-ACT concept was well received and contributed to interdisciplinary collaboration. Goal attainment scaling, functional independence measures, Berg Balance Scale scores, and Barthel Index scores are being collected to evaluate the concept, but those data are still being analyzed. In summary, combining an ICF framework and the Bobath concept offers a holistic, goal-oriented approach for SA-PwMS. By addressing individual goals, home settings, and motor learning principles, it helps sustain functional ability and supports physical independence despite disease progression.

55. The Bobath Concept Approach in Upper Limb Recovery in Patients With Multiple Sclerosis: A Case Report Using the MBCP Model

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Abstract

BACKGROUND: People with multiple sclerosis (PwMS) require therapy specifically tailored to their individual disease profile. Rehabilitation aims to maintain function, independence, and quality of life for as long as possible. The Bobath Concept offers a framework for recovery that is individualized, inclusive, and tailored to the disease's progression.

OBJECTIVE: The aim of this case presentation is to show that an intensive 5- day treatment of a PwMS can yield a consistent improvement in upper limb activity, help to reorganize the central nervous system, and improve activities and quality of life.

METHODS: The PwMS underwent therapy in our rehabilitation clinic as usual, but also received 30 minutes of Bobath therapy each day for 1 week.

RESULTS: The assessments carried out at the beginning of the therapy (T0) and at the end of the 4 sessions (T4) show an objective improvement in upper limb activity, pain, and also quality of life (Action Research Arm Test: 17 vs 24; Goal Attainment Scale: –1 vs +1; Peripheral Nerve Stimulation: 6 vs 2; Quality of Life Scale: 59 vs 71; Tinetti test: 5 vs 9; Berg Balance Scale; 6 vs 12).

CONCLUSIONS: An intensive 5-therapy session within the frame of the Bobath concept improved upper limb activity in a PwMS. The improvement was seen at the level of hand activity (grasping and releasing), elbow extension, and arm flexion. The upper-limb improvement was due to a better understanding of the multisensory integration that influences primary motor cortex output.

60. Pain Severity Is Associated With Physical Activity, Exercise Participation, and Health-Related Quality of Life in People With Multiple Sclerosis

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Abstract

BACKGROUND: Pain is common in people with multiple sclerosis (pwMS), significantly impacting quality of life, and may be associated with exercise and physical activity, although this remains largely unexplored.

PURPOSE: To estimate the prevalence and severity of pain in pwMS, and its association with physical activity, exercise participation, and health-related quality of life.

METHOD: Our survey involved 936 pwMS. Outcomes included a numerical rating scale for average pain severity ($NRS^{0\text{-}10}$), the Baecke Physical Activity Questionnaire to address physical activity ($BPAQ_{physact}$) and exercise participation ($BPAQ_{exercise}$), and a visual analog scale for health-related quality of life ($HR\text{-}QoL_{VAS}$). Participants were stratified into 3 groups: no pain (NRS = 0), mild pain (NRS = 1-2), and moderate-to-severe pain (NRS ≥ 3). Descriptive data are presented as mean ± SD or median (IQR). Linear mixed-effects models were used for statistical analysis.

RESULTS: The participant group was 73% female, age 58 ± 12 years, disease duration 17 ± 11 years, Patient-Determined Disease Steps score 2.8 ± 2.2, and pain prevalence 76% (no pain, 24%; mild pain, 24%; moderate-to-severe pain, 52%) with a median pain severity of 3 (1;5). When comparing the no-pain group with the other pain groups, differences were observed in $BPAQ_{physact}$ (no pain, 8.64 ± 2.48 points; mild pain, –0.64 [95% CI, –1.18 to –0.11; P =.018]; moderate-to-severe pain, –0.66 [95% CI, –1.12 to –0.20; P =.005]); in $BPAQ_{exercise}$ (no pain, 3.16 ± 1.76 points; mild pain, –0.47 [95% CI, –0.94 to –0.09; P = .015]; moderate-to-severe pain, –0.49 [95% CI, –0.82 to -0.17; P =.003]); and in $HR\text{-}QoL_{VAS}$ (no pain, 74.3±18.9; mild pain, –5.6 [95% CI, –9.3 to –1.9; P = .003]; moderate-to-severe pain, –19.7 [95% CI, –22.9 to –16.5; P <.001]).

CONCLUSIONS: A high pain prevalence was observed in a large, representative cohort of pwMS, along with negative associations between pain and physical activity, exercise participation, and health-related quality of life.

64. Clinical Approach to Balance Intensity in People With Multiple Sclerosis: Clinical Judgment vs the Balance Intensity Tool for Exercise

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Abstract

OBJECTIVE: Balance training is essential for enhancing stability and reducing fall risk in people with multiple sclerosis (PwMS). However, guidance on exercise intensity remains vague and largely relies on clinical intuition, as standardized assessment methods are absent. This study introduces and validates the Balance Intensity Tool for Exercise (BITE), a standardized method for determining balance exercise intensity based on observable performance errors, and compares it with traditional clinical judgment.

METHODS: Sixty-one PwMS completed line-walking and tandem-stance tasks that were recorded on video for subsequent analysis. Intensity was rated using 2 approaches: (1) BITE, where 3 assessors independently measured the percentage of time with observable errors, and (2) clinical judgment, where 3 experienced physiotherapists scored intensity on a 0-to-100 scale. Balance capacity was measured with the Mini-Balance Evaluation Systems Test (Mini-BESTest). Interrater reliability was evaluated using Bland-Altman analysis, and associations with balance capacity were examined using Spearman rank correlation.

RESULTS: BITE produced consistently lower intensity estimates than clinical judgment (line walk median, 36% vs 74%; tandem stance median, 23% vs 53%). Both methods correlated strongly with balance performance measured with the Mini-BESTest (Spearman β, –0.82). BITE demonstrated superior interrater reliability, with narrower limits of agreement (±14%-20%) compared with clinical judgment (±25%-36%). Agreement between methods was low in the midrange, indicating systematic differences in classification.

CONCLUSIONS: BITE provides a quantifiable and reliable method for describing balance exercise intensity in PwMS based on time of imbalance and performance error. Further research should explore its feasibility and applicability in other populations with impaired balance.

74. The Cost of Imbalance: How Balance Problems Drive Energy Cost of Walking in People With Multiple Sclerosis

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Abstract

INTRODUCTION: People with multiple sclerosis (PwMS) have difficulty walking with a high energy cost of walking (ECw). Balance problems may contribute to the higher ECw.

AIM: To investigate the relationship between dynamic balance and ECw in PwMS and whether walking speed affects this relationship.

METHODS: Twenty PwMS (mean age, 49.1 [10.8]; 62% female) walked on an instrumented treadmill for 6 minutes at a comfortable walking speed (CWS), followed by 6 minutes at a fast walking speed (FWS). ECw was derived from oxygen consumption measures. Dynamic balance, measured as mediolateral margin of stability (ML MoS), was calculated for the most impaired leg and the least impaired leg. In addition, balance board tests were performed as a secondary measure for dynamic balance. The relationship between dynamic balance and ECw was assessed using linear mixed models, with walking speed as the effect modifier.

RESULTS: The mean ECw at CWS was 4.99 J/kg/m and, at FWS, 4.84 J/kg/m. ML MoS was positively and significantly associated with ECw (β = 11.82, 95% CI, 2.62-21.03). Walking speed was a significant effect modifier; at lower walking speeds, a higher ML MoS was associated with a larger increase in ECw, whereas this effect diminished at higher walking speeds.

DISCUSSION: In PwMS, poorer dynamic balance was associated with higher ECw predominantly at lower walking speeds, with this association attenuating at higher speeds. This suggests that improving walking speed and dynamic balance jointly may reduce the energetic burden of walking in this population.

77. Feasibility of High Intensity Task-Oriented Circuit Training in People With Severe Multiple Sclerosis–Related Disability

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Abstract

Mobility impairments are common in people with multiple sclerosis (PwMS), limiting autonomy and participation. Motor rehabilitation is effective in reducing the impact of the disease, although benefits tend to decrease with increasing disability. This study aimed to evaluate the feasibility of high-intensity task-oriented circuit training (TOCT) in PwMS with severe motor impairment, followed by a 3-month asynchronous telerehabilitation program.

PwMS and an Expanded Disability Status Scale (EDSS) score of 6.5 or more were recruited. Participants underwent 12 TOCT sessions (3 hours each) over 4 weeks. In groups of 3, they completed 3 training rounds targeting wheelchair propulsion, bed mobility and transfers, sit-to-stand, standing balance, anticipatory postural control, and walking. Each station lasted 6 minutes, followed by 3 minutes of rest. After inpatient treatment, participants followed a home-based program with monthly remote supervision. The primary outcome was feasibility. Secondary outcomes were mobility, balance, cardiovascular endurance, fatigue, and quality of life assessed post-treatment (T1), after home intervention (T2), and at 3-month follow-up (T3).

Twelve participants completed the program (9 men; age, 51.87; EDSS, 7). The intervention was acceptable (5/5), safe (5/5), and appropriate (4/5) with no adverse events. Significant improvements were observed in balance (Berg Balance Scale: T1 +5.42, T2 +4.27, T3 +3.18), cardiovascular endurance (6-Minute Push Test: T1 +46.98, T2 +46.34, T3 +43.49), perceived balance (Activity Balance Confidence: T1 +7.03, T2 +9.93), and fatigue (Modified Fatigue Impact Scale: T2 –8.93).

TOCT is feasible in PwMS with severe mobility impairment and may improve balance, cardiovascular capacity, and fatigue. Confirmatory studies with larger samples are needed.

83. Effects of a New Complex Intervention Compared With Usual Care on Physical Functions and Work Barriers in Employed People With Multiple Sclerosis: A Randomized Controlled Trial

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Abstract

BACKGROUND: People with multiple sclerosis (PwMS) are often unemployed or in reduced positions a few years after diagnosis due to factors such as fatigue and balance and cognitive problems. Few interventions systematically address these complex challenges.

AIM: To examine the effects of a new intervention, CoreDISTparticipation, compared with usual care on work barriers, balance, and fatigue in employed PwMS.

METHODS: We conducted an assessor-blinded prospective randomized controlled trial including 115 PwMS (Expanded Disability Status Scale range, 0-4) randomly assigned to CoreDISTparticipation (n = 57) or usual care (n = 58). CoreDISTparticipation included informational videos, a hospital outpatient physiotherapist assessment, and a meeting with an employment consultant, as well as group training for 60 minutes twice a week for 6 weeks (ie, indoor CoreDIST-balance + outdoor CoreDIST-balance and high-intensity running/walking) followed by 6 weeks of digitally supported home training. Assessments: baseline, week (W) 9 and 16. Primary outcome: Multiple Sclerosis Work Difficulties Questionnaire-23. Secondary: Trunk Impairment Scale-modified Norwegian Version (TIS-modNV), Mini-Balance Evaluation Systems Test (Mini-BESTest), Multiple Sclerosis Impact Scale-29 (MSIS-29), and Fatigue Severity Scale. Statistics: descriptive and repeated-measures mixed-models.

RESULTS: Eighty-six women and 29 men participated and had a mean age of 46.9 years (SD, 9.3); 60.5% worked full-time. The results demonstrated significant between-group differences on work barriers (W9 MSWDQ-23, 6.6 points [95% CI, 3.54-9.65; $P < .001$]); balance (W16 Mini-BESTest, 0.62 points [95% CI, 0.06-2.17; $P = .03$]); trunk control (W9 TIS-modNV, 0.46 points [95% CI, 0.89-0.03; $P = .036$] and W16, 0.79 points [95% CI, 0.17-2.49; $P = .013$]) and impact of MS (W9 MSIS-29, 5.87 points [95% CI, 3.16-8.57; $P < .001$]).

CONCLUSIONS: The results indicate that a comprehensive approach addressing work, balance, and physical activity is effective in improving physical function and reducing work barriers for PwMS.

84. Patient-Reported Polysymptomatology in People With Multiple Sclerosis at the Danish MS Hospitals

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Abstract

BACKGROUND: Numerous symptoms are well documented in people with multiple sclerosis (PwMS). However, limited research has addressed polysymptomatology, the intricate interplay of multiple and concurrent symptoms. Understanding hereof could potentially have great implications for clinical referral pathways and help optimize rehabilitation strategies. We aimed to investigate this in a large cohort of PwMS referred to MS-specialized rehabilitation at the Danish MS Hospitals.

METHODS: A total of 3833 PwMS (68% female; 54±13 yrs; Patient-Determined Disease Steps score 3.1 ± 2.1; disease duration 13±11 yrs; 54% relapsing-remitting MS, 30% progressive MS, 16% unknown) were enrolled. Six common and debilitating patient-reported symptoms registered before hospitalization were selected for analysis: mobility, pain, bladder, fatigue, cognition, and depression. Each symptom was scored across 3 prevalence and severity categories: not affected, affected, or highly affected. Polysymptoms were defined as 2 or more symptoms rated *affected* or *highly affected*, whereas severe polysymptoms were defined as 2 or more symptoms rated *highly affected*.

RESULTS: High prevalences were reported across all symptoms: mobility (43% affected/35% highly affected), pain (50%/25%), bladder (36%/10%), fatigue (47%/49%), cognition (60%/18%), and depression (50%/10%). A total of 94.7% reported polysymptoms, with 6.5% reporting 2 symptoms, and 15.6%, 25.5%, 31.8%, and 18.3% reporting 3, 4, 5, and 6 symptoms, respectively. A total of 42.1% reported severe polysymptoms, with 22.6% reporting 2 symptoms and 12.3%, 5.7%, 1.4%, and 0.1% reporting 3, 4, 5, and 6 symptoms, respectively.

CONCLUSIONS: In addition to high prevalence rates across the 6 symptoms, a large proportion had polysymptoms (94.7%) and a substantial proportion had severe polysymptoms (42.1%).

86. Repetitive Acute Intermittent Hypoxia Improves Ankle Strength and Walking Endurance in People With Multiple Sclerosis

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Abstract

BACKGROUND: Motor impairment is a major consequence of multiple sclerosis (MS), yet therapies that restore motor function remain limited. Acute intermittent hypoxia (AIH) is a noninvasive intervention consisting of brief episodes of mild hypoxia interspersed with normoxia. It triggers serotonin and brain-derived neurotrophic factor–dependent signaling cascades that enhance motoneuron excitability and corticospinal drive. AIH has been shown to improve strength and walking after spinal cord injury and stroke, but data in PwMS remain scarce.

OBJECTIVE: To determine efficacy of 5-day repetitive AIH for improving ankle strength and walking speed in PwMS.

METHODS: Twenty-four PwMS (14 women and 10 men; 16 relapsing-remitting, 8 secondary progressive; Expanded Disability Status Scale [EDSS] score, 5.4 ± 1.1; age 59 ± 11 years) completed a double-blind, randomized crossover trial comparing AIH (15 cycles of 60s at 9% O_2 alternating with normoxia) with sham, with 4-week washout. Ankle plantarflexion maximal voluntary contraction (MVC), Timed 25-Foot Walk (T25FW), and 6-Minute Walk Test (6MWT) were assessed preintervention, post intervention (day 5), and at 1-week follow-up. Analysis of covariance adjusted for age, sex, MS type, disease duration, EDSS, and baseline values.

RESULTS: Plantarflexion MVC increased significantly after AIH (+17.5% post, +29.2% follow-up; $P < .001$); sham was unchanged. 6MWT improved by an estimated 10.1 meters after AIH relative to sham ($P = .039$). T25FW improved post AIH, but was not significant. Heart rate elevation during hypoxic bouts correlated with strength gains ($r = 0.58$, $P = .009$).

CONCLUSIONSS: Repetitive AIH produced significant gains in plantarflexion strength and walking endurance in PwMS. These results warrant investigation of AIH combined with rehabilitative training to enhance neuroplasticity in MS.

91. Noninvasive Neuromodulation Transforms Rehabilitation Outcomes in Progressive Multiple Sclerosis: A Systematic Review

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Abstract

BACKGROUND: Progressive multiple sclerosis (PMS) lacks effective pharmacological treatments for symptoms like spasticity, fatigue, and declining mobility. This synthesis evaluates the efficacy and feasibility of noninvasive neuromodulation (NM) techniques, including functional electrical stimulation (FES), neuromuscular electrical stimulation (NMES), and transcranial stimulation (TMS/tDCS/iTBS), as supportive neurorehabilitation for PMS.

METHODS: A systematic review and narrative synthesis assessed studies published between 2000 and 2025 that reported NM effects on PMS symptoms, focusing on quantified outcomes, tolerability, and adherence.

RESULTS: Twelve identified NM interventions showed significant clinical impact and high feasibility. Central stimulation (TMS/iTBS) significantly reduced objective spasticity (Modified Ashworth Scale, $P < .001$), with iTBS effects lasting up to 12 weeks (effect size: 1.5 points, 95% CI, –2.1 to 0.8). FES and NMES cycling significantly enhanced functional mobility over 6 months, resulting in a 13% mean increase in walking distance, a 36% acceleration in walking speed, and up to a 95% reduction in falls. Further, fine motor control was significantly improved by remotely supervised tDCS (RS-tDCS) paired with exercise, with a mean improvement of –5.85 ± 6.19 s on the 9-Hole Peg Test ($P = .049$). Even typically refractory symptoms responded to neuromodulation: hybrid FES training reduced fatigue ($P = .04$), HF-rTMS significantly alleviated pain, and RS-tDCS produced measurable improvements in quality of life ($P = .04$). High adherence was consistent across all modalities; for instance, RS-tDCS achieved 98% adherence (≥ 18/20 sessions).

CONCLUSIONS: NM interventions are safe, highly feasible, and effective adjuncts to rehabilitation for PMS. They provide targeted, measurable benefits across key domains, including spasticity, mobility, and fine motor function.

92. Dose-Response Effects of Supervised Power-Oriented Resistance Training on Lower Extremity Muscle Power and Physical Function in People With Multiple Sclerosis: Secondary Data From the NEXIMS Randomized Controlled Trial

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Abstract

BACKGROUND: Muscle power is a key determinant of physical function and health in people with multiple sclerosis (PwMS). However, no power-oriented resistance training (PowRT) studies have investigated dose-response relationships between weekly session frequency and adaptations. To address this, we conducted a 10-week randomized controlled trial.

METHODS: Sixty PwMS (72% female, age 54 ± 12 years, Patient-Determined Disease Step Scale score 2.3 ± 1.9, disease duration 12 ± 10 years, 70% relapsing-remitting) were randomly assigned (1:1:1) to 10 weeks of high-dose PowRT (HD-PowRT; 2.5 sessions/wk), low-dose PowRT (LD-PowRT; 1 session/wk), or control (CTRL). Outcomes included 5-Times Sit-to-Stand muscle power (5STS_power), 9-step stair ascend muscle power (9SSA_power), 6-Minute Walk Test (6MWT), and 12-item MS Walking Scale (MSWS12).

RESULTS: Following the 10-week intervention period, improvements followed a dose-response pattern (HD-PowRT > LD-PowRT > CTRL). Significant between-group improvements ($P < .01$) were observed for 5STS_power (0.99 [95% CI, 0.68-1.30] vs 0.36 [95% CI, 0.02-0.70] vs 0.22 [95% CI, −0.10 to 0.54] W/kg; corresponding to 24 vs 6 vs 6%), 9SSA_power (0.52 [95% CI, 0.32-0.71] vs 0.21 [95% CI, 0.00-0.43] vs −0.17 [95% CI, −0.37 to 0.04] W/kg; 15 vs 2 vs −4 %), and 6MWT (39 [95% CI, 24-54] vs 10 [95% CI, −6 to 26] vs 3 [95% CI, −12 to 18] m; 9 vs 4 vs 1%), alongside reductions ($P < .01$) in MSWS12 (−11 [95% CI, −17 to −4] vs −6 [95% CI, −13 to 2] vs −2 [95% CI, −10 to 5] points; −40 vs −23 vs −14%).

CONCLUSIONS: In the first PowRT study in PwMS, we demonstrate a dose-response relationship between weekly training frequency and improvements in lower extremity muscle power and physical function. These findings emphasize the importance of PowRT and training dosage, providing valuable insights for developing future exercise guidelines for PwMS.

93. Disruptions in One's Own Body Perception in People With Multiple Sclerosis

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Abstract

Sensorimotor deficits disrupt interactions with the environment and interfere with the continuous flow of multisensory signals to/from the body. Such disruptions may alter body perception (BP), including changes in limb ownership (eg, "This limb no longer belongs to my body."). Although BP alterations leading to sensorimotor deficits have been documented in several neurological conditions, they remain largely unexplored in multiple sclerosis.

Here, we aim to identify the presence and frequency of BP alterations in a large cohort of people with MS (PwMS) using an online survey based on the Affected Limb Perception Questionnaire. This new tool, adapted for MS, captures the frequency and severity of a broad range of BP changes, including altered ownership and perceived temperature and weight in the upper or lower limbs (UL/LL).

Findings from 203 PwMS (mean age, 52.7 ± 11.3; disease duration, 15.1 ± 11; Expanded Disability Status Scale [EDSS] score, 3.9 ± 1.9) showed frequent BP alterations (at least 1 reported alteration in 50% of patients for UL and 85% for LL), particularly in changes in ownership (UL: 27%; LL: 48%), perceived temperature (UL: 30%; LL: 62%), perceived weight (UL: 23%; LL: 89%), and involuntary movements (UL: 21%; LL: 48%). The intensity and frequency of UL and LL BP modifications significantly correlate with the self-reported disability status (EDSS, $P < .001$), with greater alterations being associated with higher disability levels.

By revealing a neglected dimension of BP in MS, our findings may highlight clinically relevant patterns that could refine diagnostic profiling and guide personalized interventions in which BP and multisensory stimulation are integrated into sensorimotor rehabilitation.

96. Feasibility and Outcomes of a 6-Month Exercise and Wellness Program in Community-Dwelling People With Multiple Sclerosis: A Cohort Observational Study

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Abstract

BACKGROUND: Although exercise is strongly recommended for individuals with multiple sclerosis (MS), few reach the exercise level recommended by evidence-based guidelines. This study aimed to determine the feasibility, safety, and outcomes of an exercise and wellness program for community-dwelling individuals with disability related to MS.

METHODS: In this pre-/postintervention uncontrolled study, individuals with MS (age 51.5 ± 11.6 years, 67% women, 67% using a walking aid) participated in supervised aerobic and strengthening exercise classes (3×/wk) and biweekly wellness education classes over 6 months at 2 community-based clinic sites. Outcomes were assessed at baseline (BL), midpoint, and end of treatment (EOT) and included the 6-Minute Walk Test (6MWT), Box and Blocks Test (BBT), strength, International Physical Activity Questionnaire Short Form, physical activity monitoring, Patient-Reported Outcomes Measurement Information System questionnaires, and Quality of Life in Neurological Disorders cognitive function questionnaire.

RESULTS: All 6 enrolled participants completed the 6-month program, attending 78% of exercise sessions. Two adverse events unrelated to the intervention occurred in 2 participants. Three (50%) participants exceeded the minimal clinically important difference (MCID) between BL and EOT on 6MWT, and 4 (67%) exceeded the MCID on the BBT for both upper extremities. Improved activity levels (a 13% increase in daily step count and a 58% increase in metabolic equivalent of task-min/wk) were also observed. Health-related quality-of-life questionnaires demonstrated modest improvements.

CONCLUSIONS: The 6-month exercise and wellness program was feasible, well tolerated, and safe. Clinically significant gains in physical activity, walking capacity, and upper extremity function were observed in at least half of the participants.

98. Can Adapted Physical Activity Provide Valuable Complementary Support When Physiotherapy Offers Benefits for an Intermittent Period? Preliminary Results from a Prospective Observational Pilot Study

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Abstract

BACKGROUND: Maintaining functional mobility and walking endurance is a major challenge for individuals with multiple sclerosis. We aimed to evaluate the association between an 8-month adapted physical activity (APA) program and changes in walking endurance, as measured by the 6-Minute Walk Test (6MWT).

METHODS: Eighteen participants were included in a pilot prospective observational study with repeated measures: 10 in the APA cohort (age 60 ± 20.7 years; Expanded Disability Status Scale [EDSS] score 2.35 ± 1.06; 5 women; 5 men) performing exercise twice weekly, and 8 in the usual care (REHAB) cohort (age 48.5 ± 14.2 years, EDSS 2.87 ± 1.70, 8 women) followed by the Associazione Italiana Sclerosi Multipla Rehabilitation Service Liguria. Assessments were performed at 3 time points (T0, T1, T2, 4-month intervals), including 6MWT, 30-second Sit-to-Stand (30STS), Timed Up and Go (TUG), Sit-and-Reach (SnR), and Modified Fatigue Impact Scale (MFIS).

RESULTS: Significant time effects were observed for 6MWT (P = .020), TUG (P = .027), and SnR (right P =.009, left P = .004). No significant time effects were found for 30STS and MFIS (P > .05). Post hoc analyses showed consistent improvements from baseline to 4 and 8 months in the APA group for outcomes with significant time effects, whereas REHAB showed variable changes. No significant group × time interactions were observed, indicating similar overall trajectories.

DISCUSSION: An 8-month APA program was associated with sustained improvements in walking endurance, functional mobility, and flexibility, whereas lower limb strength and impact of fatigue remained unchanged. Gains in APA were consistent across time points, whereas REHAB responses were variable, likely associated with the amount of rehabilitation received. Continued APA may support functional improvements alongside standard rehabilitation.

102. Effects of Neuromuscular Exercise Training Focused on the Upper Extremity on Physical and Cognitive Functions in People With Multiple Sclerosis (NExTUp): A Randomized Controlled Trial

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Abstract

OBJECTIVE: To investigate the effects of NExTUp, a structured neuromuscular exercise training program focused on the upper extremities (UE), on physical and cognitive function in people with early-stage multiple sclerosis (pwESMS).

METHODS: Forty-eight pwESMS were randomly assigned to an exercise group (EG) or a control group (CG). UE function was assessed using the 9-Hole Peg Test, Minnesota Manual Dexterity Test, and Manual Ability Measure-36; lower extremity function was assessed with the Timed 25-Foot Walk Test; and cognitive function was assessed with the Symbol Digit Modalities Test. Joint position sense, coordination, and reaction speed were evaluated using the Laser Pointer Active Angle Repetition Test, 15-White Dot Test, and BlazePod, respectively. Elbow flexion muscle and hand grip strength, postural stability, core strength and endurance, and fatigue were also assessed. EG completed an 8-week, clinic-based program (1 h/session, 2 sessions/wk) consisting of 12 UE-focused neuromuscular training stations, whereas CG maintained usual activities. EG was followed for an additional 4 weeks.

RESULTS: Forty-five participants completed the study. After 8 weeks, EG showed significant improvements across all outcomes except postural stability ($P < .01$), whereas no significant changes were observed in CG ($P > .01$). Between-group comparisons of change scores (post/pre) demonstrated significant differences favoring EG for most outcomes ($P < .01$), except for cognition and some postural stability parameters. Improvements were maintained at a 1-month follow-up.

CONCLUSIONS: NExTUp is an effective intervention for improving physical and cognitive functions in PwESMS. These findings suggest that targeting UE may extend beyond local effects, contributing to improvements across multiple functional domains, highlighting the importance of incorporating UE-focused training into MS rehabilitation.

105. Brain and Core Temperature Changes With a Neck Cooling Collar in Heat-Sensitive People With Multiple Sclerosis

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Abstract

BACKGROUND: Heat sensitivity affects up to 80% of people with multiple sclerosis (PwMS), causing temporary worsening of symptoms with increased body temperature. Cooled neck collars have been shown to be feasible to implement and to potentially reduce brain temperature and thermal discomfort in healthy populations. Given the temperature sensitivity of demyelinated neurons, their effects in heat-sensitive PwMS warrant investigation.

METHODS: Eight heat-sensitive PwMS (6 women, 2 men, aged 45-73 years) participated in a randomized crossover feasibility trial. Brain, rectal, skin, and perceptual temperatures were recorded at rest under 2 conditions: 15-minute cooled neck collar application and no cooling.

RESULTS: Data collection is ongoing, and full findings will be reported. Preliminary data from 6 participants (with complete paired data for 2) indicate trends toward increases in brain and rectal temperatures in the no-cooling condition (brain: +0.44 °C [range, +0.128 to +1.151 °C]; rectal: +0.12 °C [range, –0.02 to +0.23 °C]). With cooling, rectal temperatures tended to decrease (–0.18 °C [range, –0.34 to +0.01 °C]), and 2 of 3 participants' brain temperatures increased (+0.516 [range, –1.086 to +1.319]). Greater changes in perceptual and skin temperature were observed with cooling.

CONCLUSIONS: To our knowledge, this is the first study investigating the effects of a cooled neck collar on brain temperature in PwMS. Individual variability in temperature responses highlights the complex underlying mechanisms and will inform future sample size calculations. The completed data set may provide mechanistic insights into the contributions of physiological and perceptual temperature changes to the functional benefits of cooling observed in PwMS.

110. Immediate Effects of Combined Action Observation and Motor Imagery on Spatiotemporal Gait in Multiple Sclerosis

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Abstract

BACKGROUND: Gait impairment is one of the most common and disabling symptoms in individuals with multiple sclerosis (MS). Action observation combined with motor imagery (AOMI) has been suggested to enhance sensorimotor activation more effectively than either approach alone; however, its immediate effects on gait parameters remain unclear.

METHODS: Nineteen individuals with MS were randomly assigned to an intervention group (n = 11) or a control group (n = 8). The intervention group received a single 20-minute session of walking-based action observation combined with motor imagery, whereas the control group watched nonmotor nature videos. Spatiotemporal gait parameters were assessed using the GAITRite system before and after the intervention.

RESULTS: A significant group × time interaction was found for cadence (P = .023, β^2p = 0.267), with a decrease in the intervention group and an increase in the control group. Gait speed showed a trend toward significance (P = .063, β^2p = 0.189), with a similar opposite directional change. No significant interaction effects were observed for other gait parameters (P > .05).

CONCLUSIONSS: A single session of AOMI appears to selectively influence temporal aspects of gait in individuals with MS, particularly cadence. The reduction in cadence and trend toward decreased gait speed in the intervention group may reflect a more controlled gait pattern. The increase in the control group may be related to task familiarization and the relaxing effects of nonmotor visual input. Overall, the findings suggest modulation of gait control rather than direct improvement in performance.

112. How to Encourage Increased Physical Activity in Newly Diagnosed Patients?

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Abstract

BACKGROUND: The beneficial effects of regular physical activity for people with multiple sclerosis have been documented in numerous studies. Ideally, patients should be educated about the importance of physical activity, and interventions in this area should begin shortly after diagnosis. Therefore, the goal was to conduct a pilot study to evaluate the effectiveness of a 3-month program designed to increase physical activity among newly diagnosed patients.

METHODS: The participants were nonrandomly divided into Group 1 (motivation to exercise using pedometers and regular contact with a physical therapist), Group 2 (motivation to exercise using pedometers, dietary counseling, and regular contact with a healthy lifestyle coach), and Group 3 (control group with no lifestyle changes). Before the start and after the end of the program, participants underwent spirometry and functional mobility tests (25-Foot Time Walk Test [T25-FT], 2-Minute Walk Test [2MW], Timed Up-and-Go [TUG], and 9-ball test), as well as assessments of treatment outcomes (Modified Fatigue Impact Scale, Hospital Anxiety and Depression Scale, Falls Efficacy Scale-International).

RESULTS: A total of 33 newly diagnosed patients participated in the program (disease duration less than 3 years). Group 1 showed improvements in gait parameters: T25-FT (P = .017), 2MW (P = .006) and TUG (P = .002). Only Group 2 showed improvements in VO_2/kg (P = .026), maximum heart rate (P = .002), and Wmax (P = .021). Additionally, there was a reduction in fatigue (P = .025) and anxiety (P = .043).

CONCLUSIONS: Based on this small pilot study, it appears that exercise encouragement and dietary counseling provided individually by a healthy lifestyle coach may be effective in improving physical fitness.

115. The Effects of Trunk Rehabilitation on Balance, Gait, Falls, and Community Mobility in Patients With Multiple Sclerosis: A Single-Blind Randomized Controlled Trial

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Abstract

BACKGROUND: Multiple sclerosis (MS) impairs daily living and social engagement, reducing people's overall quality of life. Trunk impairment in people with MS (PwMS) is closely linked to balance deficits, gait disturbances, and increased risk of falls. Targeted trunk rehabilitation may improve these outcomes.

PURPOSE: Investigate the effectiveness of dynamic trunk-focused rehabilitation in PwMS.

METHODS: Forty-five PwMS were randomly assigned to either a trunk or core group. The trunk group performed multiplanar trunk exercises on unstable surfaces combined with dual-task training. The core group performed traditional core stability exercises. Both received conventional therapy. The primary outcome was the Trunk Impairment Scale (TIS), and secondary outcomes included Berg Balance Scale (BBS), Timed Up-and-Go (TUG), Modified Falls Efficacy Scale (MFES), Modified Fatigue Impact Scale (MFIS), Hospital Anxiety and Depression Scale (HADS), and Reintegration to Normal Living Index (RNLI). A 2-way mixed model analysis of variance assessed time-by-group interactions.

RESULTS: The trunk group showed significantly greater improvements across all outcomes. Significant time-by-group interactions were observed for trunk control (TIS, F=18.3, $P \leq .001$), balance (BBS, F = 13.2, $P \leq .001$), mobility (TUG, F = 3.9, $P = .05$), and community reintegration (RNLI, F = 7.6, $P = .01$). Improvements in fall prevention confidence (MFES, F = 16.4, $P \leq .001$), fatigue reduction (MFIS, F = 8.3, $P = .007$), and psychological well-being (HADS, F = 4.5, $P = .04$) were also significantly greater in the trunk group.

CONCLUSIONS: Dynamic trunk-focused interventions incorporating multiplanar movements on unstable surfaces, along with dual-task training, offer superior benefits over standard core stability exercises. These findings support incorporating dynamic trunk rehabilitation as a key component of MS rehabilitation protocols.

122. The Effects of Structured Exercise Training on Functional and Cognitive Trajectories in Newly Diagnosed Multiple Sclerosis

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Abstract

This study aimed to investigate the effects of a structured exercise training program on physical and cognitive performance parameters in people with newly diagnosed multiple sclerosis (MS). A total of 49 patients were included and randomly assigned to either the structured exercise group (SEG) or the control group (CG). All participants with MS, as well as a healthy control group, were initially evaluated in terms of muscle strength, postural sway, trunk strength and endurance, functional mobility, hand dexterity, cognitive function, and fatigue severity. The SEG received structured exercise training twice weekly for 8 weeks in addition to routine disease-modifying therapy, whereas the CG received only disease-modifying therapy. The SEG and CG were reassessed at weeks 8 and 24. A total of 7 patients were excluded during the 8- and 24-week follow-ups, and the study was completed with 42 patients (SEG = 22, CG = 20). Compared with CG, people with MS showed significant impairments in all parameters except postural sway on a firm surface with eyes open, visual and verbal memory, and the curl-up test. Following the 8-week exercise intervention, the SEG showed improvements in many functional parameters, whereas the CG demonstrated declines in some and stability in others. Structured exercise training may positively influence the course of the disease by slowing the progression of existing impairments and delaying the development of new impairments. Structured exercise training should be initiated at diagnosis alongside disease-modifying therapies and sustained throughout the disease course.

Participation, Autonomy, and Life Roles, Including Bladder and Bowel and Sexuality in Multiple Sclerosis and Related Disorders

This chapter highlights the importance of empowering people with multiple sclerosis (MS) to take an active role in symptom management to maintain autonomy, participation, and quality of life. It brings attention to urogenital dysfunction, a common yet often underrecognized condition with significant clinical consequences. By promoting awareness and introducing practical tools to support early identification and shared decision-making, the chapter addresses a critical gap in care. This contributes to improved outcomes and aligns with the broader goals of recovery and compensation in MS.

1. Balancing Participation and Fall Risk: A Constant, Ongoing Process

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Abstract

BACKGROUND: Participation is a central concept within rehabilitation. It is recommended to consider participation as a real-world outcome in multiple sclerosis (MS) fall-prevention research. Being at risk of falling may lead to limited participation in various areas of life.

OBJECTIVES: To explore how people with MS (PwMS) experience living with a risk of falling, including how that impacts participation and strategies used to maintain participation onwards.

METHODS: Twelve PwMS who had experienced 1 or more fall(s) during the past year and were not continuously using a walking device were invited to participate in individual interviews, using a semistructured interview guide. Transcriptions were analyzed using inductive content analysis.

RESULTS: The analysis identified an overarching theme of balancing participation and fall risk based on 6 subthemes. The informants described actions taken to remain in the workforce, strategies for participating in social and civic life, and efforts to continue home-based activities. They faced challenges in working life, at home, and beyond the confines of home by balancing heavy and light work tasks, shifting tasks, shifting means of transport, planning for handling variation in symptoms, organizing activities to minimize the need for long-term standing and walking longer distances, asking for help, and restricting being in busy surroundings or gatherings.

CONCLUSIONS: PwMS constantly need to find strategies to overcome fall-risk–related hurdles to maintain participation. We recommend that professionals pay attention to potential participation restrictions during their dialogues with PwMS and discuss strategies to overcome them.

3. Development and Validation of the Questionnaire for Bladder and Bowel Symptoms Screening in Patients With Multiple Sclerosis

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Abstract

Multiple sclerosis (MS) is a major cause of lower urinary tract and bowel dysfunction. Recently, a group of Italian experts developed a promising, comprehensive, and patient-oriented hybrid questionnaire in Italian on bladder and bowel symptoms in MS, following a Delphi model. The upcoming study aims to validate the new questionnaire as part of the overall patient assessment. The questionnaire will be submitted to 160 patients attending the clinic for their first visit, none of whom will have previously undergone a specific evaluation for urinary or fecal disorders. The questionnaire results will be validated through 2 independent specialist assessments conducted by centralized experts. These assessments will then be cross-checked against the hybrid questionnaire scores to determine how accurately the questionnaire identifies bladder or bowel problems. The patient will complete the new hybrid questionnaire, which consists of 9 questions on bladder habits and 12 questions on bowel habits. Internal consistency will be assessed using Cronbach α, calculated on all items and separately on the items on urinary and bowel problems. The test-retest will be assessed by intraclass correlation or Pearson correlation on 20 patients completing the questionnaire twice. The implementation of the hybrid questionnaire in Italian clinical settings is expected to improve the early identification and management of bladder and bowel dysfunctions, thereby supporting earlier intervention and potentially improving patient outcomes.

6. Development, Validation, and Clinical Use of MS Bladder Check—A Patient Self-Assessment Tool to Promote Timely Treatment of Bladder Problems

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Abstract

INTRODUCTION: Lower urinary tract dysfunction (LUTD) is common in people with multiple sclerosis (MS), yet underrecognized and undertreated.

OBJECTIVE: To develop/validate a brief patient self-assessment tool and assess its perceived clinical utility in routine practice.

METHODS: A multidisciplinary panel created a 9-item lay-language checklist covering key LUTD domains, with iterative patient testing and international expert content validation. Thirty-two health care professionals (HCPs) introduced the checklist in their clinics. Patients were asked to take the checklist before their consultation, followed by a short questionnaire to rate the impact on patient awareness and dialogue.

RESULTS: International experts rated all items excellent after the second validation round, indicating that the MS Bladder Check tool is an appropriate method of highlighting bladder problems in people with MS. Of 503 patients, 74% agreed that MS Bladder Check helps them understand the impact MS can have on bladder function, and 70% agreed it makes it easier to talk about bladder symptoms. After taking the MS Bladder Check, 28% of patients realized they had, or had previously experienced, a bladder issue. The majority (83%) of the HCPs agree that MS Bladder Check supports them in their daily work, and, when asked, they said that MS Bladder Check led to more productive dialogue, helping to concretely objectify the problems with their patients.

CONCLUSIONS: MS Bladder Check is a brief, validated self-assessment tool that empowers patients and supports timely, structured clinic discussions, with strong clinician endorsement for raising awareness, improving communication, and enabling early treatment.

7. Exploring Community Mobility in Individuals With Multiple Sclerosis: A Qualitative Study

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Abstract

BACKGROUND: People with MS (PwMS) experience various functional impairments, including muscle weakness, fatigue, balance difficulties, and psychological symptoms. Consequently, maintaining prolonged mobility presents significant challenges, impacting their community mobility and participation. Quantitative studies have found that mobility is significantly influenced by balance issues, fall incidence, and fatigue.

Although community mobility is crucial for sustaining healthy participation, there is a paucity of qualitative evidence examining the community mobility experience. Therefore, the aim of the study is to investigate the experience of community mobility from patients' perspectives to identify the factors influencing their community mobility, and discern the secondary elements related to the fundamental domains, including balance, falling, and fatigue.

METHODS: Eleven patients were recruited for the study and participated in semistructured, audio-recorded, face-to-face interviews. The study utilized qualitative data analysis software and adhered to the Braun and Clarke approach to analyze transcripts.

RESULTS: The analysis identified 4 principal themes and 10 subthemes. The primary themes included external and environmental barriers, internal physical and emotional limitations, decisions guided by awareness, and accessibility and public service considerations.

CONCLUSIONS: The findings acknowledge the distinct experiences of patients in Saudi Arabia, taking into account their environmental and cultural contexts. Furthermore, they underscore the necessity of collaboration between medical rehabilitation institutions and other governmental entities to implement strategies to enhance community mobility. This can be achieved by improving public facilities and services and increasing public awareness.

14. Transanal Irrigation Practices of Dutch Multiple Sclerosis Patients: A Retrospective Survey

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Abstract

Approximately 75% of Dutch patients with multiple sclerosis (MS) suffer from fecal incontinence and/or constipation, and 60% of them have not found a satisfactory solution for their bowel problems. Among patients with MS who use transanal irrigation (TAI) for their bowel management, little is known about the used TAI volume, frequency, impact on daily life, and dropout rates.

To investigate TAI characteristics in patients with MS in more detail, a small retrospective survey was initiated in a group of 25 patients using TAI (Peristeen Plus; Coloplast B.V.). Patients were interviewed using a combination of online questionnaires and phone interviews.

The majority (52%) received their initial Peristeen Plus prescription in hospital and had been using TAI for more than 2 years (56%). The TAI volumes used ranged from 300 to 2000 mL, with a majority (76%) using between 400 and 1000 mL per TAI procedure; 48% performed the TAI procedure daily, and 16% performed it every other day. A large majority (72%) of patients with MS could perform their TAI routine independently, without assistance, and 76% indicated that TAI added value to their daily lives. Moreover, 68% of patients with MS declared that TAI fit well with their lifestyles.

Dutch patients with MS were satisfied with their TAI treatment, which they believed added value to their daily lives, and it fit well within their respective lifestyles. Most patients with MS had been using TAI for more than 2 years, with irrigation volumes between 800 and 1000 mL, on a daily basis, to manage bowel issues effectively.

21. Evaluation of an Online Nutrition Program (NutriMS-Plus) for People With Multiple Sclerosis: Results From a Randomized Controlled Pilot Trial

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Abstract

BACKGROUND: People with multiple sclerosis (MS) are confronted with conflicting information about the influence of nutrition on MS, which makes adjustment of dietary habits difficult. To address this problem, we designed an MS-specific evidence-based online nutrition education and behavior change program (NutriMS-Plus).

OBJECTIVE: To test the feasibility and acceptance of NutriMS-Plus and to collect preliminary effectiveness data on nutrition-related outcomes.

METHOD: We evaluated NutriMS-Plus, consisting of 12 modules, in a preregistered pilot randomized controlled trial. Eligible participants were randomly assigned to 3 groups: IG1 (NutriMS-Plus), IG2 (NutriMS-Plus and individual online nutritional counseling), and CG (waitlist control group). Measurements were taken at baseline and 12 weeks after. Feasibility outcomes included recruitment success, practicality, adherence, and acceptance. Nutrition-related outcomes were MS-specific nutrition knowledge (MSNKQ), MS-specific food literacy (MSFLQ), and diet quality (sDQS).

RESULTS: Between June and September 2025, 57 pwMS (89.5% female, mean age 43.8 years, mean disease duration 8.6 years, mean Patient-Determined Disease Steps 1.9) were recruited. On average, IG participants completed 11.7 (IG1) and 11.5 (IG2) modules. All participants completed the study and rated the online platform's usability as very good. Acceptance, as measured with the Theoretical Framework of Acceptability Questionnaire, exceeded the benchmark of 3 (range, 1-5) in both intervention groups (IG1: 3.8; IG2: 4.0), indicating high acceptance. Significant improvements in MSNKQ, MSFLQ, and sDQS were observed in IG1 and IG2 compared with the CG, with a trend toward better results in IG2.

CONCLUSIONS: All predefined progression criteria were met. NutriMS-Plus will now be tested in a full-scale randomized controlled trial.

36. What Matters to Whom? Identifying Patient Priority Profiles in Short-Term Multiple Sclerosis Rehabilitation

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Abstract

BACKGROUND: Inpatient rehabilitation programs are typically organized around clinician assessments of patients' best interests, yet less is known about how patients prioritize different rehabilitation domains themselves. The aim of this retrospective analysis is to understand inpatients' priorities in short-term rehabilitation trajectories.

METHODS: Prior to admission to a 3- to 4-week rehabilitation program, patients with multiple sclerosis (MS) completed a questionnaire assessing the priority they assigned to a range of rehabilitation domains. Associations between demographic and clinical characteristics and priority ratings were examined using nonparametric statistics.

RESULTS: Preliminary analyses of 270 inpatients with MS revealed several systematic patterns in patient-reported priorities. Younger patients assigned higher priority to sexuality and intimacy (rs = –.207, P = .001), emotions and purpose (rs = –183, P = .002), and professional functioning and education (rs = –.210, P = .001). Women gave a higher median priority score to emotions and purpose (U = 9805, P = .040), whereas men prioritized sexuality and intimacy to a larger extent (U = 7327, P = .034). Higher disability levels (Expanded Disability Status Scale scores) were associated with greater prioritization of transfers (rs = .335, P = .008), but lower prioritization of lifestyle (rs = –.293, P = .022), emotions and purpose (rs = –.350, P = .006), and recreational activities (rs = –.298, P = .020).

DISCUSSION: The interpretation of these findings will be further refined by exploring these factors in a latent profile analysis. These profiles are expected to support more personalized goal setting and more efficient allocation of rehabilitation resources in short-term inpatient programs.

37. Developing a Shared Multidisciplinary Vision on Positioning in Multiple Sclerosis: Baseline Evaluation, Training Pathway, and Implementation Strategy

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Abstract

BACKGROUND: Optimizing sitting and lying positioning for people with multiple sclerosis (MS) is essential for comfort, functional performance, and the prevention of complications such as pressure injuries. To improve consistency and quality of positioning practices, the National MS Center established a multidisciplinary working group to develop a shared vision and translate it into a sustainable training program for all involved disciplines. This project examined how a unified approach and structured training could enhance positioning quality, and which needs and experiences were identified by staff and patients.

METHODS: A positioning check was developed for use by both staff and people with MS. During a baseline measurement, 100 inpatients were systematically assessed over 1 week regarding their positioning in bed and a wheelchair. A self-developed observation checklist was used. In parallel, staff and patient surveys were conducted to map current skills, perceived responsibilities, and unmet needs. Findings informed the design of a training program with discipline-specific and interdisciplinary learning objectives aimed at improving positioning competencies and fostering interprofessional collaboration. An implementation plan is being developed to structurally embed the acquired knowledge into onboarding and continuous professional development.

CONCLUSIONS: Anticipated outcomes include improved positioning adapted to daily activities, enhanced functional performance, reduced complication risk, and clearer role distribution across disciplines. This project suggests that a systematic, interdisciplinary approach has the potential to support quality improvement in MS care and may evolve into a transferable model for other rehabilitation settings where positioning is a key component of practice.

52. Beyond Mobility: An AI-Enabled Personalized Narrative Intervention to Address Family Participation in Multiple Sclerosis Rehabilitation—A Case Study

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Abstract

BACKGROUND: Multiple sclerosis (MS) is a chronic, multidimensional condition affecting not only bodily functions but also participation in meaningful life roles, including parenting. Within the International Classification of Functioning framework, participation restrictions, particularly in family roles, are often underaddressed. Communicating disease-related changes to young children represents a significant challenge.

OBJECTIVE: To describe an innovative, personalized, artificial intelligence (AI)–assisted narrative intervention aimed at improving parent-child interaction and participation.

CASE DESCRIPTION: A man aged 36 years with MS (Expanded Disability Status Scale 5) was admitted for inpatient rehabilitation due to recurrent falls, instability, and fatigue. These impairments led to activity limitations and significant participation restrictions, including withdrawal from his parental role. His 2 daughters, unaware of his condition, had developed fear and avoidance behaviors.

INTERVENTION: In addition to multidisciplinary rehabilitation, a personalized children's storybook was developed near discharge using an AI platform. Guided by clinical insight, the narrative translated disease-related impairments into age-appropriate metaphors (eg, fatigue as *a battery*, weakness as *spaghetti legs*) and reframed the walking aid as a supportive *helper*. The story incorporated personalized family elements and provided children with concrete ways to engage and respond.

OUTCOMES: The patient reported significant emotional impact and meaningful engagement, including shared reading with his children.

CONCLUSIONS: This case highlights the importance of addressing participation-level challenges in MS rehabilitation. AI-enabled personalized storytelling represents a feasible and innovative approach to bridging communication gaps and supporting family-centered care. Such interventions may expand the scope of rehabilitation beyond traditional domains toward more holistic, person-centered models.

56. Social Participation Through Attendance at Concert Performances in Rehabilitation

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Abstract

A new activity was introduced into the inpatient rehabilitation program in which people with multiple sclerosis (PwMS) attend a 1-hour concert in a concert hall in Brussels, Belgium. This initiative, organized by the music therapist in collaboration with the social services department, aims to enhance social participation as a core health objective and to help prevent social isolation. This project aims to explore participants' experiences with the activity and perceived benefits.

Within 1 week following the concert, we performed individual interviews with participants.

So far, 8 PwMS with a variety of mobility aids (scooter, manual wheelchair, cane, or electric wheelchair) were interviewed. Five participants indicated that they would also like to attend concerts outside the rehabilitation setting, whereas 3 expressed less interest in doing so.

Participants identified several barriers to participation in community-based cultural activities, including mobility challenges (eg, traveling with a scooter), limited toilet accessibility, the need for personal assistance, and uncertainties related to parking. Overall, the duration and structure of the activity were considered appropriate. The positive evaluations were partly attributed to the fact that practical obstacles—such as parking and organizational logistics—were addressed within the rehabilitation program.

These findings suggest that cultural activities can meaningfully support social participation and well-being during rehabilitation. However, to facilitate sustained participation beyond the clinical setting, both individualized support (micro level) and broader structural measures (macro level), such as accessible infrastructure and transportation, are essential.

58. Access to Inpatient Medical and Rehabilitation Care for Patients With Multiple Sclerosis: A Nationwide French Analysis Using the National Health Data System (2017-2023)

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Abstract

BACKGROUND: Inpatient stays in Medical and Rehabilitation Care (MRC) units help maintain functional independence and limit disability progression in patients with multiple sclerosis (PwMS). Access to MRC may, however, be unevenly distributed across socioeconomic and geographical strata in France.

OBJECTIVES: To analyze MRC utilization trends among PwMS in France (2017-2023) and identify socioeconomic and geographical inequalities in access.

METHODS: PwMS were identified from the French National Health Data System using a validated algorithm combining long-term disease registration, MS-related hospital admissions, and disease-modifying drug reimbursements (2012-2021). From this prevalent cohort, all MRC stays were identified between 2017 and 2023, stratified by administrative district and the French social deprivation index.

RESULTS: The study included 130,015 PwMS (72.1% female; mean age 54.0 ± 14.5 years). In 2023, 9.5% had at least 1 MRC stay; 81.3% were MS-related, predominantly day care admissions (67.8%). Annual MRC admissions grew by 6.8% per year from 2017 to 2019, dropped 16.7% in 2020 (ie, COVID-19 impact), then rebounded by 9.6% per year through 2023. Utilization was higher in men, patients over 50 years, and those with a disease duration exceeding 15 years. Patients from the most deprived areas showed slightly higher rates (8.4% vs 7.7%). Marked interregional disparities persisted, with utilization ranging from less than 5% to greater than 15% across districts.

CONCLUSIONS: MRC utilization increased overall despite a temporary COVID-19–related decline. Age, sex, and disease duration are key access determinants. Persistent geographical and socioeconomic disparities highlight the need for more equitable rehabilitation provision across France.

59. Development and Validation of the Multiple Sclerosis Autonomy Scale

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Abstract

BACKGROUND: Autonomy, based on the ability to fulfill the roles that matter most to oneself, is poorly covered by existing multiple sclerosis (MS) scales, which are often symptom- or disability-centered. A new tool is needed.

OBJECTIVES: Develop and validate the psychometric properties of the Multiple Sclerosis Autonomy Scale (MSAS), a patient-reported outcome codeveloped with patients and care teams, in accordance with FDA guidelines.

METHODS: The Ambition Autonomy project guided the development of the MSAS via qualitative interviews (20 patients, 12 health care professionals). The baseline MSAS (131 items, 13 dimensions) was refined in FOCAL-MS-1 to 36 items in 10 dimensions based on feedback from 653 patients and robust psychometric analyses. The FOCAL-MS 2 study (186 patients) evaluated structure, test-retest reliability, and convergent/discriminant validity vs Expanded Disability Status Scale (EDSS) scores.

RESULTS: The final MSAS (35 items, 10 dimensions) demonstrates excellent reliability (β = 0.92; intraclass correlation coefficient = 0.90) and low correlation with the EDSS (r = 0.26), confirming that it captures dimensions of autonomy distinct from neurological disability as measured by the EDSS. The median completion time for the questionnaire is 8 minutes, favoring its clinical integration. The dual rating of impact and importance for each dimension allows a fine-tuned and personalized assessment of lived autonomy.

CONCLUSIONS: Coconstructed with patients at every stage of development, the MSAS offers a robust, unique measure of autonomy combining impact and importance ratings for a comprehensive, individualized assessment that complements existing symptom- and disability-centered MS scales.

62. Management of Heat Sensitivity in People With Multiple Sclerosis: A Cross-Sectional Analysis of a Survey Conducted by the Swiss Multiple Sclerosis Registry

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Abstract

INTRODUCTION: Many people with MS (PwMS) are temperature-sensitive, most of them to heat. Cooling can counteract the transient symptom worsening caused by heat exposure and improve quality of life. However, evidence on awareness and the use of different cooling methods (CMs) is limited.

AIM: To assess the frequency of temperature sensitivity in pwMS and examine awareness and use of different CMs in a real-world setting.

METHODS: This cross-sectional analysis included data from 760 respondents of a thematic survey on temperature sensitivity and CMs conducted by the Swiss Multiple Sclerosis Registry. Descriptive statistics and logistic regression analyses were performed.

RESULTS: Overall, 73.3% of respondents reported being temperature-sensitive (heat: 48.8%; heat and cold: 18%; cold: 6.4%). Of the respondents, 471 (62%) were aware of CMs. The most frequently cited sources of information were the Swiss Multiple Sclerosis Society (58.2%), peers with MS (23.8%), and physiotherapists (16.1%). Of the 348 respondents who reported being sensitive to heat or heat and cold and who were aware of CMs, 154 (44.3%) used them, most frequently cold showers (48.7%), ventilators (46.1%), and cooling cloths (33.8%). Awareness was associated with sex, symptom burden, temperature sensitivity, and region of residence. Use was associated with Swiss citizenship.

DISCUSSION: Although many heat-sensitive respondents are aware of CMs, they do not use them. As various CMs are used, it is difficult to provide uniform recommendations on their practical application. Reasons for nonuse and perceived effectiveness of individual CMs still need to be investigated, as do the reasons why health care professionals may not be advising PwMS sufficiently on CMs.

65. Understanding Productivity Loss in Multiple Sclerosis: Indirect Costs, Work-Related Quality of Life, and Resource Use

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Abstract

INTRODUCTION: Multiple sclerosis (MS) commonly affects individuals during their prime working years, reducing work capacity and quality of life. This study is part of a broader research project funded by the Italian Workers' Compensation Authority (Bando BRiC 2022, ID 31), titled "RiaL SM: The rehabilitation approach as a qualifying factor in the evaluation of reasonable accommodation in workers with Multiple Sclerosis." The cross-sectional survey presented here constitutes the initial exploratory phase of the RiaL SM project. Within this framework, the study aimed to evaluate work productivity loss, work-related quality of life (WRQoL), and health care and social resource utilization among Italian workers with MS (WwMS), and to identify predictors of productivity-related indirect costs.

METHODS: A cross-sectional study was conducted on 160 WwMS. Work productivity and activity impairment were assessed using the Work Productivity and Activity Impairment Questionnaire: Multiple Sclerosis, and work-related difficulties were assessed using the Multiple Sclerosis Questionnaire for Job Difficulties (MSQ-Job). WRQoL and health care and social resource utilization were measured using validated instruments. Productivity losses were monetized using national wage data. Two-part regression models were applied.

RESULTS: Overall, 79.4% of WwMS reported productivity loss, mainly due to presenteeism (76.9%), with mean work impairment of 40.3%. The mean annual cost was €12,580, and 83% was attributable to presenteeism. Costs were higher in those reporting work difficulties based on MSQ-Job cut-off (€13,992 vs €7,098; $P < .001$). Lower WRQoL, higher fatigue, and greater health care needs were associated with higher productivity losses.

CONCLUSIONS: MS-related work difficulties generate substantial indirect costs, largely driven by presenteeism. Vocational rehabilitation interventions targeting workplace well-being and fatigue may reduce productivity losses and improve quality of life.

70. Implementation Science Approach to an Interdisciplinary Vocational Rehabilitation Model for Multiple Sclerosis: A CFIR-Informed Evaluation of the RiaL SM Project

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Abstract

INTRODUCTION: People with multiple sclerosis (PwMS) frequently experience work-related difficulties that affect quality of life. The RiaL-SM project evaluated an interdisciplinary vocational rehabilitation (VR) approach to address needs in the rehabilitative, reasonable accommodation, and educational-informative areas.

MATERIALS AND METHODS: Two surveys, informed by the Consolidated Framework for Implementation Research, were administered to workers with MS (WwMS) enrolled in RiaL SM and to VR professionals involved in the intervention. The WwMS survey explored clarity, usefulness, flexibility, and impact on work functioning of the 3 intervention areas. The professionals' survey investigated perceived utility, compatibility with routine practice, organizational readiness, barriers, and training needs.

RESULTS: Twenty-two WwMS (mean age, 48.1 ± 12.1 years; 68% full-time work) completed the survey. The VR program was rated as "quite/very" useful (82%), "quite/very" clear (95%), and "quite/very" able to improve work conditions (83%). Across the 3 areas, professionals' ability to understand needs and identify appropriate solutions was rated as very strong (80.3%). The solutions identified were considered "quite/very" appropriate to the work situation (41.3%). Eight professionals participated; 100% rated the program "quite" useful, and all were willing to receive further training. Internal communication emerged as a key facilitator and was rated very effective (75%). Human resources were rated as insufficient by 63%, and 38% found that personnel were only partially prepared for implementation.

CONCLUSIONS: The RiaL SM model is perceived as useful and acceptable, with facilitators such as team communication and program adaptability. However, challenges emerged, suggesting that scale-up requires increased human resources and training.

78. Experiential Knowledge Shapes People-Centered Innovation and Strengthens Resilience, Agency, and Life Roles in People With Multiple Sclerosis

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Abstract

People with multiple sclerosis (PwMS) hold experiential knowledge that reflects real-life needs, priorities, and daily constraints and is essential for shaping innovation. This is especially true in rehabilitation, where progress requires personal commitment and consistency. Active participation in research and innovation improves the relevance and usability of solutions while strengthening the sense of agency, self-worth, and social roles of PwMS. For many PwMS, this represents a shift from being "patients" to being meaningful contributors, helping reduce negative perceptions of the disease and fostering resilience. Within the European Union–funded TEN4CARE project, which focuses on developing innovations for tendon disorders, PwMS are engaged through codesign activities, needs-mapping, and iterative feedback. Tendon disorders are often an indirect consequence of MS, due to altered movement patterns, muscle imbalance, and compensatory strategies. When tendon injury occurs, immobilization becomes especially harmful, increasing the risk of accumulating disability. TEN4CARE addresses this challenge by developing a minimally invasive treatment, complemented by targeted training content, that enables prevention, effective rehabilitation pathways, and faster recovery with the goal of preserving mobility and functional independence. PwMS contribute to identifying needs, advising on feasibility and acceptability, and guiding device features and use cases. Codesigned awareness and training activities support empowerment and promote preventive and functional rehabilitation practices. PwMS facilitate acceptability, act as trusted ambassadors, and contribute to early dialogue with regulators. Engagement generates mutually reinforcing benefits: It enhances research quality and supports a more transparent and inclusive innovation pathway, while strengthening personal agency, self-worth, and social identity.

97. Quality of Life in an Employed Population of People With Multiple Sclerosis and Effects of a Complex Intervention Directed at Physical Functioning, Physical Activity, Work, and Quality of Life

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Abstract

INTRODUCTION: Quality of life (QOL) is lower for people with multiple sclerosis (PwMS) than the general population, impacted by fatigue, cognition, depression, disability, and social factors; however, it can improve with tailored care. The aim was to investigate the status of health-related and general dimensions of QOL in an employed population with MS in Norway and the effects of CoreDISTparticipation, an intervention directed toward work barriers, physical activity, function, fatigue, and QOL.

METHODS: An assessor-blinded prospective multicenter randomized controlled trial included 115 PwMS (Expanded Disability Status Scale score range, 0-4) randomly assigned to CoreDISTparticipation (n = 57) or usual care (n = 58). The intervention consisted of informational videos outpatient physiotherapist-assessment, and employment consultant meeting; group physiotherapy (twice a week, 6 weeks); and digitally-supported independent training (twice a week, 6 weeks). Assessments occurred at baseline, week 9, and week 16. Descriptives and repeated measures mixed models were used. Outcomes were the EuroQual 5-Dimension (EQ5D) index and EQ5D visual analog scale (EQ5D VAS), the Satisfaction with Life Scale-3 (SWLS-3), and generic QOL questions.

RESULTS: Participants were 86 women and 29 men with a mean age of 46.9 years (SD, 9.3). Mean baseline scores were EQ5D index 0.819 (SD, 0.149) and EQ5D VAS 66.25 (SD, 16.996), slightly above population norms (index: 0.805 [SD, 0.201], VAS: 77.9 [SD, 18.3]). The mean SWLS-3 was 13.559 (SD, 4.208), and 16.3% reported high satisfaction with life (> 9-10/10), lower than the general population in Norway (21%). Meaning in life was rated at 7.3 (1.971), above the population average in Norway (6.7/10).

There were significant group differences in reported feelings of joy (P = .049; 95% CI, –0.95 to 0.00) and for feelings of anxiety (P = .04; 95% CI, 0.01-1.41), favoring the intervention group at 16 weeks. Otherwise, there were no significant group differences.

CONCLUSIONS: Reported QOL at baseline varies when compared with population averages. There were group differences in affective QOL, but otherwise no significant differences between groups at any timepoints.

99. "It's Like Adding Another Layer": Women's Experiences of Menopause as a Disruptive Transition in Multiple Sclerosis

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Abstract

BACKGROUND: The menopausal transition may influence the well-being of women living with multiple sclerosis (MS), yet research in this area is limited. We aimed to gain insight into women's lived experiences of MS during menopause.

METHODS: Four in-person focus group discussions were conducted with women with MS across different stages of the menopausal transition. Data were analyzed using reflexive thematic analysis guided by Braun and Clarke's framework.

FINDINGS: Twenty women aged 41 to 67 years participated. Three overarching themes were identified: 1) menopause as an intensifying and destabilizing layer, 2) impact on everyday functioning and social roles, and 3) fragmented care and the need for self-advocacy. Participants described menopause as intensifying and overlapping with existing MS-related symptoms, including fatigue, cognitive difficulties, mood changes, pain, and sexual dysfunction, thereby disrupting established balance with MS. This compounded symptom burden affected multiple areas of daily life, including reduced work capacity, withdrawal from employment, participation in social life, and strain in intimate relationships. Health care was perceived as fragmented across specialties, with menopausal symptoms often dismissed, minimized, or redirected. In the absence of coordinated support, women assumed responsibility for researching symptom management and actively advocated for interventions, including hormone therapy.

CONCLUSIONS: Women experienced menopause as a significant and underrecognized contributor to complexity in living with MS, with implications for daily life as well as physical and psychosocial well-being. Greater clinical awareness and improved coordinated care are essential to support women with MS through this transition.

117. Difficulties in Coping With Temperature Changes in People With Multiple Sclerosis

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Abstract

BACKGROUND: In clinical practice, it is important to distinguish between transient worsening of neurological symptoms caused by an infection or by other factors, such as temperature changes, in people with multiple sclerosis (MS). Our goal was to objectively assess the frequency of symptoms caused by temperature changes and to investigate strategies for managing these symptoms.

METHODS: A survey was developed to assess these difficulties and distributed online via patient organizations.

RESULTS: A total of 724 people with MS (82% women) completed the questionnaire, representing a range of neurological deficits and disease duration. A total of 75% of participants reported experiencing worsening symptoms due to temperature changes, 14% were unsure, and 11% did not experience worsening symptoms due to temperature changes. A majority have difficulty coping with heat (58.7%), followed by both heat and cold (37.6%), and only 3.7% with cold. The most common symptoms worsened by heat are fatigue (83%), muscle weakness (50%), and walking (49%). Worsening of symptoms is most often caused by hot weather (87%), changes in weather (40%), and hot baths (30%). To cope with heat-related difficulties, patients most often choose light, breathable clothing (63%) and limit their activities (63%). A total of 76% of respondents would welcome more information on managing these difficulties.

CONCLUSIONS: Temperature sensitivity is very common, and it is important to provide patients with information on appropriate lifestyle adjustments and assistive devices as part of their rehabilitation.

119. Beyond Symptom Management: What People With Multiple Sclerosis Value in Physiotherapy and Occupational Therapy

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Abstract

OBJECTIVE: Multiple sclerosis (MS) challenges an individual's daily functioning, independence, and participation. Physiotherapy and occupational therapy are regarded as essential elements of disease management, yet the perspectives and values of people with MS (PwMS) regarding these therapies across the disease course are underexplored.

METHODS: We combined a nationwide online survey (n = 193) with in-depth interviews (n = 23) to capture use, experiences, values, satisfaction, and barriers related to physiotherapy and occupational therapy among Dutch PwMS. Quantitative data were analyzed descriptively; qualitative data were analyzed thematically (survey) and with interpretative phenomenological analysis (interviews).

RESULTS: Physiotherapy was widely known and used (97% ever used, 88% current use); occupational therapy was known by 96% and used by 75% (25% current). PwMS highly valued both therapies throughout all disease stages, not only for maintaining mobility and independence, but also for fostering self-determination in living with MS. Patient values evolved dynamically with disease progression and life circumstances. Five key themes emerged: values related to the patient, therapist, patient-therapist relationship, therapy content, and interprofessional collaboration. Satisfaction was high, especially regarding trust, contact, and involvement in therapy decisions. Barriers included distance, mobility, transport, and financial issues. PwMS emphasize the need for MS-specific expertise, truly personalized adaptive care, integrated multidisciplinary collaboration, and the reduction of practical and financial barriers.

CONCLUSIONS: PwMS highly value physiotherapy and occupational therapy across all disease stages. Their needs and expectations are dynamic and multifaceted, underscoring the importance of personalized, accessible, and MS-specific allied health care. Adapting therapy to the evolving values and needs of PwMS is crucial for empowering autonomy and quality of life.

123. Prevalence of Pelvic Floor Dysfunction and Interest in Rehabilitation

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Abstract

BACKGROUND: Bladder and bowel problems are among the typical symptoms of multiple sclerosis (MS). Our goal was to investigate the prevalence of bladder and bowel incontinence and sexual difficulties among people with MS who have varying degrees of neurological disability.

METHODS: We used a questionnaire survey that combined the standardized International Consultation on Incontinence Questionnaire, Overactive Bladder Questionnaire, MS Intimacy Scale, Hospital Anxiety and Depression Scale, Fatigue Severity Scale, and our own questionnaire in a group of 308 people with MS (84% women).

RESULTS: The mean age of respondents was 46.3 years (SD, 11.4) with a disease duration from 0 to 49 years (mean, 14.2; SD, 10.2) and a mean Patient-Determined Disease Step score of 2.5 (SD, 1.9; range, 0-8). Of respondents, 67% cited urinary incontinence, 25% fecal incontinence, and 58% sexual difficulties. It is shocking that 25% reported that their treating neurologist never asked them about these symptoms. Incontinence aids were used by 43%, and more than 66% would be interested in specialized rehabilitation (they expressed the most interest in video-based exercises or individual physiotherapy).

CONCLUSIONS: Given the prevalence of these difficulties, targeted education on assistive devices and tailored exercises based on patient preferences (individually or via telerehabilitation) would be advisable.

125. The NBD-MS Instrument: A New Tool to Assess Neurogenic Bowel Dysfunction and Its Invisible Burden in People With Multiple Sclerosis

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Abstract

BACKGROUND: About two-thirds of people with multiple sclerosis (PwMS) are believed to experience bowel symptoms such as constipation and fecal incontinence. Existing questionnaires fail to exhaust the symptoms pwMS experience, including the life-altering burden and changes that may ensue from managing bowel symptoms. Therefore, the authors sought to develop a new tool specifically designed to help assess bowel symptoms and their impact on PwMS.

METHODS: A 12-item questionnaire on bowel symptoms and their repercussions, specifically developed for PwMS through multinational patient interviews and international Delphi processes, was promoted and distributed to Danish PwMS. Short questions on background information, gastrointestinal comorbidities, and quality of life (QOL) were also included. The association between questions and QOL was calculated with logistic regression analysis, where only questions significantly correlated with QOL were included, and points were assigned to each response category equivalent to the OR.

RESULTS: Responses were received from 588 PwMS. One question was excluded. Calculations resulted in 2 separate scores. *The Burden Score* consists of 6 questions: satisfaction with current bowel regimen, abdominal discomfort, worries, altering activities, and oral and rectal medications. *The Symptom Score* consists of 5 questions: frequency of defecation, sensation of incomplete emptying, duration of defecation, fecal incontinence, and urge.

CONCLUSIONS: Authors have developed a new tool, the NBD-MS instrument, consisting of a burden score and a symptom score, for assessing bowel symptoms and their burden in PwMS.

127. Physical Medicine and Rehabilitation–Led Multidisciplinary Coordination: Implementing an ICF-Based Model to Optimize Rehabilitation Pathways in Multiple Sclerosis

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Abstract

INTRODUCTION: Multiple sclerosis (MS) requires comprehensive, continuous care to address evolving functional deficits. Standard community services often result in fragmented care. A coordinated multidisciplinary approach is essential to align rehabilitation intensity with patient-specific needs and ensure clinical continuity.

OBJECTIVES: To evaluate the efficacy of a newly established physical medicine and rehabilitation (PM&R)–coordinated multidisciplinary MS rehabilitation center, focusing on pathway adherence and the transition from episodic assessment to longitudinal care.

METHODS: A retrospective analysis was conducted on 29 people with MS (58.6% female; mean age, 50.2 ± 12.4 years; median Expanded Disability Status Scale score, 6.0) evaluated at our multidisciplinary clinics. Patients were stratified into tailored pathways: inpatient, day-hospital, targeted outpatient, or home-based rehabilitation. Primary outcomes included pathway adherence and completion rates. Additionally, a novel PM&R specialist clinic for functional monitoring was implemented.

RESULTS: International Classification of Functioning, Disability, and Health (ICF)–guided precision routing of patients with moderate-to-severe disability resulted in 48.3% to day-hospital, 20.7% to inpatient, 20.7% to outpatient, and 10.3% to home-based rehabilitation. Adherence rates were exceptionally high: 85.7% adhered to the day-hospital and 83.3% to the inpatient pathways. To sustain functional gains, a dedicated PM&R follow-up clinic was launched, successfully conducting 3 clinical sessions to date.

CONCLUSIONS: Early data confirm that an ICF-based, PM&R-led stratification model successfully matches patients with MS to the correct rehabilitation intensity, yielding high adherence even in a population with advanced disability. Integrating a dedicated PM&R specialist clinic is a critical step in evolving from episodic care to a continuum, directly addressing the progressive nature of MS.

129. Defining Individual Nursing Objectives With People With Multiple Sclerosis in an Interdisciplinary and Shared Decision-Making Rehabilitation Setting

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Abstract

BACKGROUND: Patient-centered goal setting is widely implemented in multiple sclerosis (MS) rehabilitation but remains challenging to apply in nursing practice. It is important to structure and translate patients' expectations into individualized objectives and action plans.

PURPOSE: To describe a framework for patient-tailored nursing goal setting in an interdisciplinary MS rehabilitation center.

METHODS: Before admission, patients are invited to express expectations via an online questionnaire. Upon admission, a nurse is assigned to each patient and acts as a counselor and main contact within the nursing team throughout the rehabilitation. Nursing objectives are developed through a 4-step approach. First, the designated nurse conducts an intake to evaluate patient expectations. Second, functional skills and limitations, as well as health literacy, are assessed. Next, patient-centered objectives are determined using SMART criteria (specific, measurable, achievable, recently relevant, and time-bound). Finally, nursing objectives are refined with the patient and operationalized into a care plan. In an interdisciplinary team meeting that includes the patient as an equal team member, treatment goals are discussed and prioritized. Regular follow-up by the designated nurse ensures monitoring and adjustment of the care plan.

RESULTS: It is anticipated that implementation of this goal-oriented framework is feasible and may enhance motivation, engagement, autonomy, shared decision-making, ownership of care, increase knowledge, and improve interdisciplinary alignment.

CONCLUSIONS: This approach seems valuable in MS nursing rehabilitation, although research on this topic is necessary to provide evidence-based nursing. Defining nursing objectives within an interdisciplinary setting may reinforce the crucial role of nurses in improving the quality of care and life for people with MS in complex rehabilitation pathways.

151. Anorectal Dysfunction in Multiple Sclerosis: Individualized Rehabilitation and Therapeutic Perspectives

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Abstract

BACKGROUND: Anorectal dysfunction, including fecal incontinence, constipation, impaired rectal sensation, and evacuation disorders, is a frequent but underrecognized manifestation of multiple sclerosis (MS). These symptoms substantially impair quality of life, social participation, and autonomy, yet MS-specific therapeutic evidence remains limited.

METHODS: Placed within the current therapeutic landscape, we present our clinical and research experience with individualized rehabilitation in people with MS with anorectal dysfunction. In our pilot study, patients completed a 6-month biofeedback-based rehabilitation program. Outcomes were assessed using high-resolution anorectal manometry and the St Mark Fecal Incontinence Score at baseline, after supervised physiotherapy, and following a period of self-management.

RESULTS: Individualized rehabilitation was associated with improvement in symptom severity according to the St Mark score, whereas manometric parameters did not demonstrate statistically significant change. These findings suggest that clinically meaningful patient-reported benefit may occur despite the absence of measurable normalization of anorectal physiology. Current evidence supports a stepwise approach including bowel routine optimization, dietary and fluid measures, toileting education, pharmacological support, and pelvic floor rehabilitation with biofeedback. In refractory cases, advanced strategies such as transanal irrigation or neuromodulation may be considered.

CONCLUSIONS: Individualized rehabilitation appears to represent a clinically relevant component of comprehensive care for anorectal dysfunction in MS. Further controlled MS-specific studies are needed to define treatment algorithms and predictors of response.

Psychosocial and Cognitive Rehabilitation in Multiple Sclerosis and Related Disorders

This chapter explores recent advances in psychosocial and cognitive rehabilitation in multiple sclerosis (MS), moving beyond symptom-focused approaches toward integrated models that combine recovery, compensatory strategies, and real-world participation, using both technological and traditional tools. Abstracts address the development of normative data for digital cognitive screening to support routine clinical practice, alongside the feasibility of vocational rehabilitation interventions aimed at enhancing work participation and daily functioning. Critical perspectives on diversity and inclusivity in neuropsychological rehabilitation research are discussed, highlighting gaps in representation and their implications for equitable care. Overall, this chapter offers a multidimensional view of rehabilitation for invisible symptoms, bridging methodological innovation, clinical application, and a strong focus on participation and inclusion.

9. Representation Matters: A Review of the Current State of Diversity and Inclusivity Within Multiple Sclerosis Clinical Trials of Neuropsychological Rehabilitation

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Abstract

Multiple sclerosis (MS) affects individuals across diverse demographic and socioeconomic backgrounds, yet it is unclear whether neuropsychological rehabilitation trials adequately reflect this diversity. A systematic review was conducted to assess the state of representation and diversity in MS neurorehabilitation clinical trials.

The following databases were searched: SCOPUS, PubMed, Cochrane Library, PsycINFO, ProQuest, International Standard Randomized Controlled Trial Number registry, and ClinicalTrials.gov. Randomized controlled trials (RCTs) published between 2015 and 2025 were included. Data were extracted using a bespoke extraction form that captured demographic reporting, eligibility criteria, recruitment pathways, and patient and public involvement (PPI) within the trials.

Across 118 RCTs, only 14 (11.86%) reported participant ethnicity. Eligibility criteria commonly excluded individuals who did not complete foundational schooling, had limited language proficiency, multimorbidity, higher disability levels, or severe cognitive impairment. Recruitment strategies were largely clinic-based and seldom designed to reach underserved groups; 20 (16.94%) studies used community recruitment. PPI involvement was reported in 17 (14.40%) publications, indicating a limited involvement of people with MS in shaping research design or delivery.

These findings suggest that key demographic and clinical groups are underrepresented and/or not reported in neuropsychological rehabilitation trials. This risks reinforcing structural inequities in terms of who can participate and benefit. Addressing these gaps is essential for developing interventions that are equitable, accessible, and relevant to the full diversity of people living with MS.

16. Beyond Balance: The Role of Body Trust in Fear of Falling in Multiple Sclerosis

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Abstract

INTRODUCTION: Fear of falling (FoF) is common in people with multiple sclerosis (PwMS) and is often attributed to impaired balance. However, the role of interoceptive awareness, how individuals perceive and interpret bodily signals, remains unclear. This study examined the associations between interoceptive awareness, objective balance, and FoF in PwMS.

METHODS: Seventy-seven PwMS (mean age, 43.8 years [SD, 11.2]; 58 women; mean Patient-Determined Disease Steps score, 2.4 [SD, 1.9]) participated in this study. FoF was assessed using the Falls Efficacy Scale-International (FES-I). Interoceptive body awareness was evaluated by the Multidimensional Assessment of Interoceptive Awareness (MAIA), including its 8 subscales. Objective balance performance was measured using the Mini-Balance Evaluation Systems Test (MiniBESTest).

RESULTS: Pearson correlation analysis revealed a strong negative association between MiniBESTest and FES-I score ($r = -0.70$; $P < .001$), indicating that poorer balance was associated with higher FoF. Among the MAIA subscales, only the trusting subscale was significantly associated with FoF ($r = -0.34$; $P = .002$), with lower body trust linked to higher fear. A multiple linear regression model including all MAIA subscales and MiniBESTest scores was performed to assess independence from objective balance. The overall model was significant ($R^2 = 0.58$; $P < .001$), with both MiniBESTest ($\beta = -0.95$; $P < .001$) and Trusting ($\beta = -2.61$; $P = .015$) independently associated with FoF. The interaction term between the trusting subscale and MiniBESTest was not significant ($P = .733$), indicating that these factors contribute independently to FoF.

CONCLUSIONS: FoF in PwMS is associated not only with impaired balance but also with reduced body trust. These factors contribute independently, suggesting that addressing interoceptive processes, in addition to balance rehabilitation, may help reduce FoF.

18. Assessing Unmet Social Needs in Multiple Sclerosis Care in Australia: A Qualitative Assessment of Feasibility, Barriers and Enablers

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Abstract

BACKGROUND: Unmet social needs (including housing, transport, and social inclusion) contribute substantially to health outcomes, especially for people with long-term health conditions such as multiple sclerosis (MS). Whether assessment of unmet social needs occurs in MS clinical care is unclear. This study aims to understand current practices, identify barriers and enablers to social needs assessments, and explore the feasibility of social needs screening tools in MS care.

METHODS: This qualitative descriptive study comprised focus groups and interviews with clinicians, carers, and people with MS in Australia. We inductively and deductively coded transcripts and used applied thematic analysis to identify themes, using COM-B (Capability, Opportunity, Motivation, Behavior) and Feasibility frameworks.

RESULTS: Participants (11 clinicians and 8 lived-experience participants) reported inconsistent and unstructured social needs assessment in MS care. Barriers aligned with capability (lack of referral pathway knowledge), opportunity (resources), and motivation (belief in abilities, evidence of value, consumer skepticism). Enablers aligned with capability (clinician rapport, consumer self-advocacy), opportunity (care coordination, self-paced assessment), and motivation (mutual desire for positive patient outcomes). A social needs screening tool was considered acceptable, conditional on adequate resourcing and/or design to ensure identified needs can be addressed.

CONCLUSIONS: Findings suggest that the current integration of social care in MS health care in Australia is inadequate. We identified opportunities to develop and test a screening tool and supporting referral resources to identify and address unmet social needs among people with MS. Better-integrated social and health care represents a promising avenue for improving comprehensive MS management.

25. Developing Normative Data for 2 Online Cognitive Screening Tasks to Support Routine Neuropsychological Screening in Multiple Sclerosis Clinics in the United Kingdom

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Abstract

BACKGROUND: Cognitive difficulties affect up to 70% of people with multiple sclerosis (MS) and are associated with reduced daily functioning and lower quality of life. To support early routine identification, the NEuRoMS program has developed 2 online cognitive screening tasks: the Symbol Substitution Task (SST) and the Word Color Task (WCT). This study aimed to generate United Kingdom (UK)–based normative data and cognitive impairment thresholds for both tasks.

METHODS: A cross-sectional online study recruited 431 adults for the SST (mean age 41.6, [SD, 14.32]) and 432 adults for the WCT (mean age 40.25, [SD, 13.89]) without an MS diagnosis to complete the tasks remotely on mobile devices. Descriptive statistics and SD-based impairment thresholds were calculated. Multiple linear regression was used to examine demographic predictors, and regression-based norms were generated.

RESULTS: Age significantly predicted performance on both tasks (SST coefficient = –0.39, $P < .001$; WCT coefficient = –0.36, $P < .001$), with scores decreasing as age increased. Education predicted SST performance (coefficient = 2.40, $P = .017$), and gender predicted WCT performance (coefficient = –3.88, $P = .003$), with women and those with degree-level education or higher achieving higher scores. Raw impairment thresholds were established, and 2 regression-based norming approaches were used to develop age-categorical lookup tables and age-continuous equations for automated adjusted norms.

CONCLUSIONS: These UK-based norms provide population-specific reference values for these online tests and support a more nuanced interpretation of cognitive screening results within MS clinics.

This project was funded by the National Institute for Health and Care Research (NIHR) under its Programme Grants for Applied Research (RP-PG-0218-20002). The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

33. Vocational Rehabilitation for Workers With Multiple Sclerosis in the Italian Context: Feasibility and Explorative Results

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Abstract

INTRODUCTION: Job retention is a key health outcome for workers with multiple sclerosis (WwMS). Vocational rehabilitation (VR) provides targeted interventions to help WwMS overcome work difficulties. However, evidence regarding the feasibility and effectiveness of VR for WwMS is poor.

METHOD: We conducted a VR feasibility study involving 30 participants with a confirmed diagnosis of MS who experienced work-related difficulties (Multiple Sclerosis Questionnaire for Job Difficulties score > 15.8). VR involved the implementation of rehabilitation programs to manage symptoms at work, an assessment of reasonable accommodations (RA), and educational programs to raise WwMS' rights awareness. VR was implemented based on individual needs, identified during an initial interview. Each participant was eligible to receive 1 or more of these 3 intervention programs.

RESULTS: The 30 WwMS reported the following characteristics: age mean (SD): 48.1 (12.1) years; female/male: 19/11; disease course relapsing-remitting 21, primary progressive 2, secondary progressive 7; disease duration mean (SD): 14.7 (11.2) years; Expanded Disability Status Scale score mean (SD), 4.8 (2.0). The program with the highest uptake was education (90%), followed by rehabilitation (87%) and RA (73%). Eighteen (60%) individuals required interprofessional support in all 3 areas; 9 (30%) required support in 2 intervention areas; 3 (10%) required only 1 intervention. Adherence to each VR program was 89% for rehabilitation, 78% for education, and 55% for RA. The majority (68%) of WwMS perceived an improvement in working conditions, as measured by the Global Perceived Effect.

CONCLUSIONS: Despite its complexity, the VR program has been feasible with high adherence to the rehabilitation and educational programs and can improve perceived working conditions.

42. Don't Be Late! Qualitative Process Evaluation of a Preventive Work Coaching Intervention for People With Multiple Sclerosis

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Abstract

BACKGROUND: Multiple sclerosis (MS) often leads to premature work disability. This study describes the experiences of employed people with MS who underwent a preventive work intervention within the Don't Be Late! study.

METHOD: The intervention consisted of 4 months of one-on-one coaching by an expert-by-experience MS coach. Semistructured interviews (N = 13) and a focus group (N = 6) were conducted to capture participant experiences with the work intervention and to identify implications for future implementation. Transcripts were analyzed using thematic analysis.

RESULTS: Thematic analysis of the interviews identified 4 relevant themes: expectations, engagement with the intervention, experiences with the intervention, and recommendations for implementation. The focus group reflected on these themes and the underlying intervention principles. Most participants were unsure what to expect from the intervention. Identifying a work-related challenge sometimes proved difficult because participants did not yet have a concrete support need. Participants who did identify a work-related challenge experienced the intervention as valuable. The lived experience expertise of the MS coaches gave participants a sense of recognition and validation. The personal and flexible approach was appreciated. Although employer involvement was an intervention component, this often did not occur because good work arrangements were already in place, the diagnosis had not been disclosed, or participants were self-employed.

CONCLUSIONS: Coaches with lived experience can play a valuable role in work-focused interventions for people with MS. Identifying a challenge and tailored support also prove to be important. Further research is needed into the optimal moment of delivery and the involvement of the employer.

43. CALM: Creating Awareness and Lasting Management of Overstimulation in People With Multiple Sclerosis and Functional Neurological Disorder

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Abstract

Many people with multiple sclerosis (MS) or a functional neurological disorder (FND) experience overstimulation, which limits daily functioning and lowers quality of life. MS and FND differ in etiology: MS involves structural damage, whereas FND involves disrupted brain functioning without damage. Their complementarity will help us better understand and treat people with various brain disorders experiencing overstimulation. Recognition of overstimulation is difficult. People use the term differently, and existing patient-reported outcome measures (PROMs) may not adequately capture what is meant when people refer to overstimulation. Moreover, no evidence-based treatment exists.

With the CALM study we aim (1) to determine how people describe overstimulation and test whether existing PROMs align with lived experience through analysis of online posts, psychometric validation, and interviews; (2) to study relationships among overstimulation, cognitive and psychological symptoms, fatigue, and brain functioning using PROMs, neuropsychological assessments, and functional MRI to help us identify overstimulation profiles; and (3) to develop and evaluate e-CALM, an innovative, blended e-health intervention designed to enhance personal and functional recovery. e-CALM provides education and strategies to lower the threshold for exposure to external stimuli, followed by graded exposure therapy (first in VR, then in daily life).

Feasibility and acceptability will be tested in a later pilot study. Then, we will conduct a randomized controlled trial comparing e-CALM with enhanced standard care. Finally, we will examine whether overstimulation profiles predict treatment response.

The CALM study will advance our understanding and recognition of overstimulation and deliver an innovative, widely applicable treatment, tailored to those who could benefit the most.

48. Home-Based Serious Game Therapy to Improve Cognition in Multiple Sclerosis: A Randomized Trial

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Abstract

Cognitive impairment affects up to 65% of people with multiple sclerosis (PwMS), with prominent deficits in information processing speed and memory. Although conventional cognitive rehabilitation has demonstrated efficacy, innovative and accessible approaches such as serious game therapy (SGT) may enhance engagement and treatment outcomes.

We aim to describe the protocol of a randomized controlled trial (RCT) evaluating the clinical efficacy of a tablet-based, home-delivered cognitive rehabilitation program using SGT compared with standard neuropsychological rehabilitation in PwMS.

This study is a double-blind, parallel-group RCT including 150 ambulatory PwMS randomly assigned (1:1) to tablet-based SGT or conventional cognitive exercises. Both interventions will be delivered over 4 months with four 20-minute sessions per week. A blinded evaluator will assess cognitive outcomes at baseline (T0), postintervention (T1), and at the 6-month follow-up (T2). The primary end point will be cognitive performance measured using the Brief International Cognitive Assessment for Multiple Sclerosis, focusing on information processing speed and episodic memory.

It is hypothesized that the SGT intervention will lead to greater improvements in processing speed and episodic memory compared with conventional rehabilitation, reflecting enhanced learning engagement and training intensity.

This trial will provide clinically relevant evidence on the effectiveness of an accessible, home-based digital intervention for cognitive rehabilitation in MS. If effective, SGT could represent a scalable and patient-centered approach to improving cognitive outcomes and long-term functional independence in PwMS.

68. Understanding Work-Related Difficulties in People With Multiple Sclerosis: A Person-Centered Approach

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Abstract

BACKGROUND: Multiple sclerosis (MS) onset typically occurs during the most productive years of adult life, causing a reduction in or loss of employment, which may occur even in the early stages of the disease. This study aims to describe the work-related difficulties among workers with MS (WwMS) using a person-centered approach.

METHODS: Thirty WwMS who reported work-related difficulties (Multiple Sclerosis Questionnaire for Job Difficulties score > 15.8) were included. Sociodemographic and clinical data were collected. Work-related difficulties were identified using the Canadian Occupational Performance Measure, a semistructured interview that allows the identification of up to 5 problematic activities in which the individual wishes to improve performance and satisfaction.

RESULTS: The 30 WwMS (age, mean [SD]: 48.1 [12.1] years; female/male: 19/11; disease course, relapsing-remitting 21, primary progressive 2, secondary progressive 7; disease duration, mean [SD]: 14.7 (11.2) years; Expanded Disability Status Scale score, mean [SD]: 4.8 [2.0]) reported a total of 107 work-related difficulties, with a mean (SD) of 3.6 (1.0) difficulties per person. The most reported difficulties concerned the management of symptoms (26%, n = 28), environmental factors and workplace accessibility (23%, n = 25), psychological and relational areas (15%, n = 16), and organizational and management aspects (15%, n = 16). Less frequently reported were difficulties related to limited disease knowledge and stigma (9%, n = 10), commuting to the workplace (6%, n = 6), and limited knowledge of workers' rights (6%, n = 6).

CONCLUSIONS: The results highlight that WwMS experience a wide range of work-related difficulties, mainly related to symptom management and physical accessibility of the workplace. Psychological, relational, and organizational challenges are also present, although less frequently reported.

69. READY for MS: Development, Feasibility Trial, and Pilot Study of an Acceptance and Commitment Therapy–Based Online Intervention for People With Multiple Sclerosis

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Abstract

The unpredictable nature of MS exacerbates psychological distress and negatively impacts quality of life. Although many people with MS (PwMS) experience psychological distress up to and including relevant psychiatric comorbidities, there is a lack of psychotherapeutic interventions. In addition, only a few therapeutic interventions target resilience. As resilience, the ability to bounce back from adversity, is a key factor in coping with chronic diseases, we developed and feasibility-tested an adapted German online version of the group-based resilience-enhancing program READY for MS.

The program of 8 modules with an additional booster session included videos, exercises, a personal plan, and a workbook. In a single-arm feasibility study with 19 PwMS (age: 39.11 years, SD = 12.91; sex: 79% female), we collected data to assess program usability, perceived personal experiences and benefits, and impressions and suggestions for improvement with postintervention surveys. In structured qualitative interviews with 5 participants, we collected additional data to measure satisfaction with the program and to get more information regarding usability and applicability in depth.

The program was well accepted, and both qualitative and quantitative findings indicated high satisfaction and perceived benefit. Participants reported greater self-reflection, awareness, and stress-resistance and suggested minor structural and technological improvements. Quantitative results (n = 19) indicated positive effects of the program on resilience (Connor-Davidson Resilience Scale, $P = .039$), quality of life (Hamburg Quality of Life Questionnaire in Multiple Sclerosis, $P = .019$), and psychological flexibility (Multidimensional Psychological Flexibility Inventory: flexibility $P < .001$; inflexibility $P = .024$)

The German online version of READY for MS appears to be a feasible and well-accepted intervention to support resilience in PwMS.

71. Body Image, Interoceptive Awareness, and Psychological Factors in People With Multiple Sclerosis

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Abstract

Multiple sclerosis (MS) symptoms, such as sensorimotor and cognitive effects and mood disorders, may be linked to changes in body image (BI). BI is the subjective representation that each person has of their body and is fundamental to the awareness, development, and maintenance of an individual psychological identity. This study aims to examine the relationship between BI, interoceptive awareness, and psychological and neuropsychological factors in people with MS (PwMS).

Participants completed an online questionnaire collecting sociodemographic (age, gender, education) and clinical data (eg, self-reported Expanded Disability Status Scale score [self-EDSS], disease duration). Self-report measures assessing interoceptive awareness (Multidimensional Assessment of Interoceptive Awareness [MAIA]), health status (Short-Form Health Survey 12 [SF-12]), perceived cognitive deficits (Multiple Sclerosis Neuropsychological Screening Questionnaire [MSNQ]), and body image (modified Body Image Scale [mBIS]).

The final sample included 208 PwMS (144 women; age 50.9 ± 14.6 years; disease duration 14.7 ± 11.1 years; self-EDSS 4.0 ± 1.96). Spearman correlations showed that mBIS was mildly correlated with different MAIA subscales: noticing ($\beta = 0.274$; $P < .001$), not worrying ($\beta = -0.314$; $P < .001$), attention regulation ($\beta = -0.188$; $P < .001$), self-regulation ($\beta = -0.297$; $P < .001$), and moderately correlated with trusting ($\beta = -0.530$; $P < .001$). mBIS was also moderately correlated with SF-12 ($\beta = -0.665$; $P < .001$) and MSNQ ($\beta = 0.447$; $P < .001$).

These findings suggest that in PwMS, BI distress is linked to all the MAIA subscores: bodily awareness, anxiety and worry, difficulties in attention and emotion regulation, and reduced trust in the body. BI distress was further associated with poorer perceived health-related quality of life and greater perceived cognitive deficit. Overall, the results suggest that interventions promoting adaptive bodily awareness and regulation may support psychological well-being in PwMS.

73. Living With Advanced Multiple Sclerosis: A Qualitative Study of Psychosocial Challenges

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Abstract

INTRODUCTION: A substantial number of people with multiple sclerosis (PwMS) reach an advanced stage characterized by severe impairment and need daily assistance. This study explored the central psychosocial consequences of living with advanced MS from the perspectives of PwMS and their close relatives.

METHODS: Seventeen individual in-depth interviews with PwMS were supplemented by individual and group interviews with 9 close relatives. Data were analyzed thematically.

RESULTS: Three interconnected themes captured central psychosocial challenges. First, both PwMS and relatives described loss of autonomy and identity. As daily life became dominated by care schedules, physical limitations, and dependency, PwMS described losing autonomy and personal identity. Relatives experienced parallel losses as care responsibilities permeated their daily lives, affecting their independence and life roles. Second, reduced social participation was pervasive. Mobility limitations, fatigue, and lack of accessibility hindered the involvement of PwMS in social and meaningful activities, and participation required extensive planning. Relatives often withdrew from their own social engagements to maintain caregiving and support. Several participants described losing social connections as the disease progressed. Third, emotional strain and uncertainty about the future were prominent. Participants expressed sadness, frustration, and worry about further decline and how it might affect living situations, relationships, and their ability to cope.

CONCLUSIONS: The study illustrates how advanced MS affects psychosocial well-being for PwMS and their relatives. The findings highlight the importance of rehabilitation practices that integrate both physical and psychosocial perspectives, ensuring that both PwMS and their relatives receive support aligned with the complexities of everyday life with advanced MS.

79. Sex Differences in Coping Strategies Among Caregivers of People With Multiple Sclerosis: A Cross-Sectional Study

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Abstract

BACKGROUND: Data on sex differences in coping across caregivers of people with chronic conditions are inconsistent. Women favor emotion-focused strategies, whereas men favor problem-focused strategies, although studies show convergence. Evidence for caregivers of people with multiple sclerosis (PwMS) is limited.

OBJECTIVE: To examine sex differences in coping strategies among family caregivers of PwMS.

METHODS: Eligibility required caring for PwMS who are not fully independent. Two hundred caregivers (51% male; mean age, 58.7) completed the Coping Orientation to the Problems Experienced (COPE-NVI-25) with standardized subscale scores. Sex differences were analyzed using β^2 or Fisher exact tests for categorical variables and nonparametric tests for continuous variables.

RESULTS: Male caregivers were older (60.5 ± 12.7 vs 56.7 ± 12.4 years; *P* = .009), more frequently married or cohabiting (90.2% vs 79.6%; *P* =.048), and partners of the care recipient (80.4% vs 58.2%; *P* = .006). No differences emerged in education, employment, geography, caregiving years, or caregiving hours per day. Women reported higher religious coping (2.31 ± 1.17 vs 1.89 ± 1.02; *P* = .006) and social support (2.11 ± 0.63 vs 1.89 ± 0.52; *P* = .015). Problem-focused and positive-attitude strategies were most used and comparable across sexes; denial was least used, with no significant differences.

CONCLUSIONS: Caregivers of PwMS show convergent coping, differing only in religious coping and social support. Convergence on problem-focused strategies aligns with the progressive trajectory of MS. Greater religious coping by women may reflect a strategy for managing distress. Male caregivers, predominantly spouses, report lower social support, possibly because their primary source of support is the care recipient. Despite accounting for sex, these findings reveal a pattern consistent with gender norms in coping strategies.

82. REMOTE-MS: Synchronous Cognitive Telerehabilitation for People With Multiple Sclerosis

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Abstract

INTRODUCTION: The REMOTE-MS project evaluates the noninferiority of synchronous cognitive telerehabilitation compared with traditional in-person treatment for people with multiple sclerosis (PwMS), aiming to improve access and continuity of care.

METHODS: PwMS from Italian Multiple Sclerosis Association Rehabilitation Services of Liguria (Genoa) and Como were randomly assigned to an experimental group (EXP, telerehabilitation) or a control group (CTRL, in-person). Both groups performed cognitive exercises via the Medico Amico Pro app for 16 sessions over 8 weeks. EXP participants used tablets for remote connection with a neuropsychologist, whereas CTRL participants received on-site care. Assessments were conducted at baseline (T0), postintervention (T1), and at the 8-week follow-up (T2). The primary outcome was the Symbol Digit Modalities Test (SDMT); secondary outcomes included the Brief Visuospatial Memory Test-Revised (BVMTR), California Verbal Learning Test Second Edition, and usability/satisfaction (System Usability Scale [SUS]/Client Satisfaction Questionnaire-8 [CSQ-8]).

RESULTS: To date, 33 participants have completed the intervention (mean age, 54.6; Expanded Disability Status Scale score, 4.55). SDMT scores improved by more than 4 points in both groups (T0: 40.84; T1: 44.24). A significant improvement over time was found for visuospatial memory (BVMTR, $P < .05$). No significant differences were observed regarding other secondary outcomes. Usability (SUS) was excellent in both groups (EXP: 82.26; CTRL: 82.92), and satisfaction (CSQ-8) was high (28.69).

CONCLUSIONS: Preliminary findings indicate improvements in processing speed and visuospatial memory across both settings, with excellent usability. If noninferiority is confirmed in the full sample (N = 130), telerehabilitation could significantly reduce economic and environmental impacts while ensuring equitable access to care.

85. Unraveling Exercise Response to Fatigue in People With Multiple Sclerosis: Who Benefits and Why? Secondary Analysis from the MSBOOST Trial

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Abstract

INTRODUCTION: Fatigue is a common and debilitating symptom in people with multiple sclerosis (PwMS). Although pharmacological treatments provide limited relief, exercise has shown promising benefits. However, it remains unclear whether fatigued and nonclinically fatigued PwMS respond differently to the same exercise intervention and whether baseline characteristics differ between responders and nonresponders.

OBJECTIVE: To compare responses to a standardized exercise intervention (aerobic and resistance training) in fatigued vs nonclinically fatigued PwMS and identify baseline characteristics of responders and nonresponders.

METHODS: A total of 150 PwMS (45 ± 8 years; Expanded Disability Status Scale score 2.7±1.6; 73% women) were randomly assigned to 12 weeks of aerobic training (AT, n = 60), resistance training (RT, n = 60), or usual care (n = 30). Fatigue status was defined using a cutoff of 38 points on the Modified Fatigue Impact Scale (MFIS). Responders were those exceeding the minimally important difference of 3.84 points after intervention.

RESULTS: Exercise (AT and RT combined) reduced $MFIS_{total}$ compared with control (–8.3 [95% CI, –16.0 to –1.1]; a comparable response was observed following AT (–8.3 [95% CI, –17.6 to 0.9]) and RT (–5.6 [95% CI, –14.9 to 0.3]). Fatigued PwMS showed greater reductions in $MFIS_{total}$ (–6.0 [95% CI, –10.8 to –1.1]) and $MFIS_{cognitive}$ (–3.2 [95% CI, –5.6 to –0.8]) than nonclinically fatigued PwMS, whereas changes in $MFIS_{physical}$ were borderline (–2.2 [95% CI, –4.8 to 0.3]). Responders had higher baseline $MFIS_{total}$ (11.0 [95% CI, 4.1-17.9]) and longer disease duration (5.6 [95% CI, 2.2-8.8] years) than nonresponders, with no other differences observed.

CONCLUSIONS: Both AT and RT reduce fatigue in PwMS. Greater benefits were observed in fatigued individuals, and responders exhibited higher baseline fatigue and longer disease duration. These findings highlight the importance of exercise interventions targeting fatigued PwMS.

89. A New Way to Communicate With the Disease—The Role of Personification in Emotional and Functional Aspects in Multiple Sclerosis: A Longitudinal Point of View

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Abstract

BACKGROUND: Illness personification theory posits that individuals experiencing chronic illness ascribe human characteristics to their illness, which impacts their adaptation. Whereas negative or malevolent personification of chronic illness derails adaptation, positive or benevolent personification yields a complex pattern with aspects of adaptation. This study aimed to examine, for the first time, the role of personification in people with multiple sclerosis (PwMS) and compare it with that of people with psoriasis (PwPs).

METHODS: Study 1: A 2-wave design was implemented with 250 people with MS. The Illness Personification Scale was administered alongside a host of adaptation-related variables relating to salutogenic, psychological, psychopathological, and health aspects. Study 2: Two cohorts of PwMS and PwPs were evaluated with personification and mental distress indicators, as well as the Body Image Scale.

RESULTS: Study 1 replicated the structure of personification, with good test-retest reliability for negative (interclass correlation [ICC] = 0.81; $P < .001$) as well as for positive personification (ICC = 0.76; $P < .001$). Negative personification was associated with psychological and psychopathological aspects, whereas positive personification was associated with salutogenic adaptation. Study 2 found that latent depression/anxiety was higher in PwPs than in PwMS (b = 3.89; b = 2.27). The serial mediation model explored an indirect effect from Illness type to body perception to negative illness personification, culminating in latent depression/anxiety.

CONCLUSIONS: The findings suggest that negative personification may be a risk factor for adaptation in MS, highlighting the need for a more in-depth exploration of the implications of positive personification. Additionally, a disease's visibility appears to influence this dynamic.

90. Wartime Stress and Relapse Risk in People With Multiple Sclerosis: A Prospective Cohort Study

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Abstract

INTRODUCTION: Psychological stress has been proposed as a trigger for disease activity in people with multiple sclerosis (PwMS), but findings have been inconsistent. Although prior research has focused largely on chronic stressors, little is known about how PwMS cope with acute, large-scale stress events such as war.

OBJECTIVES: Examine the effects of wartime stress on disease activity in PwMS after the October 7, 2023, attack and assess whether emotional factors are associated with relapse risk during this period.

METHODS: Clinical data on relapses and disability progression were collected retrospectively for the year preceding October 7, 2023, and prospectively for the year following that date. Participants completed standardized questionnaires assessing stress, anxiety, depression, fatigue, and coping flexibility between April and June 2024.

RESULTS: From the 145 PwMS included in the prospective study, 38% experienced at least 1 relapse in the postwar year, compared with 23% in the year prior. Perceived fatigue was significantly higher among those who experienced relapses, whereas anxiety, depression, and perceived stress were not significantly associated with relapse frequency. Coping flexibility did not moderate the relationship between psychological distress and relapse count. No significant difference in disability progression was observed between the 2 time periods.

CONCLUSIONS: Wartime conditions were associated with increased relapse activity in PwMS. Fatigue may serve as a sensitive marker of disease vulnerability during stress. Coping flexibility, as measured in this study, did not appear to buffer the effects of psychological distress on relapse risk.

108. Exploring the Cognitive Care Provision for People With Multiple Sclerosis at a Single-Center Multiple Sclerosis Unit in Ireland Across a 10-Year Time Period

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Abstract

Cognitive impairment affects up to 70% of people with multiple sclerosis (MS), and international guidelines recommend baseline cognitive screening, regular review, and access to specialist occupational therapy. This study aimed to evaluate the impact of introducing an occupational therapy service on the provision of cognitive care within a single neurorehabilitation service in Ireland. A pre/post study design was used, examining cognitive care practices at 2 time points. A data collection tool captured demographic and cognitive data from a random sample of 140 people with MS. Time 1 represented current cognitive care (2022; n = 70), whereas Time 2 represented care before the introduction of the occupational therapy service (2012; n = 70). Data were analyzed to compare cognitive screening, identification of cognitive needs, and related clinical practices across the 2 periods.

Cognitive care provision increased markedly following the introduction of the occupational therapy service. Cognitive screening rates rose substantially in 2022, with 15 individuals referred specifically for cognitive concerns and a further 48 identified opportunistically during sessions for other reasons, indicating a shift toward routine cognitive inquiry. The sharp rise in identified cognitive deficits suggests improved detection and greater clinical attention to cognition. Notably, despite increased documentation of cognitive needs, a higher proportion of individuals were driving in 2022, suggesting that enhanced cognitive assessment and support may help maintain participation in instrumental daily activities, including driving. Overall, the findings indicate that occupational therapy played a central role in expanding cognitive care and improving the identification of cognitive impairment among people with MS.

116. An Occupational Therapy Group Intervention to Address Sleep Disturbances in Individuals With Multiple Sclerosis

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Abstract

Sleep disturbances affect up to 60% to 80% of individuals with multiple sclerosis (MS) and are closely linked to fatigue, decreased daily functioning, and reduced quality of life. However, structured sleep-focused interventions within occupational therapy remain scarce. This study aimed to develop and evaluate the feasibility and preliminary effects of a novel occupational therapy group intervention targeting sleep in people with MS.

A 5-week group program was developed, inspired by fatigue management principles and grounded in the Person-Environment-Occupation-Performance Model. The intervention was tested with 2 groups (n = 8) using a single-subject A-B-B1 design. Participants completed daily self-ratings of sleep quality and daytime tiredness (1-10 scale) across baseline, intervention, and follow-up phases. Secondary outcomes were assessed using standardized scales for sleep quality, daytime sleepiness, fatigue impact, and disease-specific quality of life. Feasibility and participant experience were assessed through a postintervention questionnaire.

Visual analysis showed clear positive trends across the group. Mean sleep quality and daytime tiredness improved by 42% from baseline to follow-up. Low-energy days (< 3) decreased, indicating greater day-to-day stability. Individual trajectories varied, with steady, delayed, or fluctuating responses, indicating that changes reflect personal and contextual differences. Secondary outcomes supported these findings, with clinically meaningful improvements (80% and more) in sleep, fatigue, and disease impact for most participants.

Survey responses indicated high satisfaction with content, structure, and peer support. These findings suggest that a structured, occupation-focused sleep intervention is feasible, well received, and potentially effective in MS rehabilitation, warranting larger controlled studies.

118. Translating Research Into Practice: Occupational Therapy for Multiple Sclerosis

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ABSTRACT

OBJECTIVE: Despite the recognized benefits of occupational therapy (OT) for people with multiple sclerosis (PwMS), the translation of evidence into clinical practice remains a significant challenge, highlighting the need to bridge the know-do gap. This project aimed to review the effectiveness of OT interventions for PwMS and map the facilitators and barriers to evidence-based practice to develop an implementation plan.

METHODS: We conducted a Cochrane systematic review of OT effectiveness in PwMS, an international clinician survey, and a mapping review of barriers and facilitators across the 6 levels of the Grol and Wensing framework. Findings are categorized using the Consolidated Framework for Implementation Research and linked to Expert Recommendations for Implementing Change strategies.

RESULTS: We found 20 studies (1628 participants) showing OT may offer short-term benefits for daily functioning (standardized mean difference [SMD], 0.22-1.19) and mental quality-of-life (QOL) (SMD, 0.33-0.68), but certainty of evidence is low, particularly regarding long-term effects and in severe cases or low-resource settings. Adverse effects were rarely reported. Effects on physical QOL and participation were small, inconsistent, or very uncertain. Barriers to implementation were multifaceted (limited time, insufficient training, organizational constraints, lack of mentorship). Key facilitators were motivation, peer support, and access to resources. A 5-step implementation plan was developed.

CONCLUSIONS: OT interventions may improve daily functioning and mental health-related QOL in PwMS, particularly in the short term. Better-designed trials with consistent outcome reporting are needed to strengthen the evidence base. A stepwise context-sensitive implementation approach is needed to develop sustainable evidence-based OT for PwMS and to close the evidence-practice gap in MS care.

120. Neuropsychological Interventions in Progressive Multiple Sclerosis: A Systematic Review

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Abstract

BACKGROUND: Progressive multiple sclerosis (PMS) is associated with ongoing disability progression, for which pharmacological therapies often have limited impact. There is a growing need for neuropsychological approaches to maintain functioning and quality of life in people with PMS. However, the evidence guiding such interventions remains fragmented and poorly implemented in clinical practice. This systematic review synthesizes evidence for psychosocial and cognitive rehabilitation interventions in people with PMS and identifies implications for neuropsychological assessment, intervention, and service delivery.

METHODS: Studies published from 2000 to 2025 that examined nonpharmacological interventions targeting neuropsychological outcomes in adults with PMS were identified. Eligible studies included psychological, behavioral, or cognitive rehabilitation interventions reporting cognitive, emotional, or functional outcomes.

RESULTS: Psychological and behavioral treatments were consistently associated with improvements in emotional well-being, adjustment, and acceptance of progressive disease. Mindfulness- and acceptance-based approaches strengthened psychological flexibility and self-efficacy, whereas energy conservation programs reduced fatigue impact and supported daily functioning. Qualitative findings highlighted the value of group delivery and peer support in enabling behavioral change and maintaining participation. Cognitive rehabilitation approaches demonstrated varied effects. Compensatory and therapist-led approaches improved self-awareness, strategy use, and everyday cognitive functioning. Computer-based cognitive training yielded variable objective cognitive outcomes but often improved subjective cognition and mood. Interventions were feasible, with strong adherence and acceptability. Remote and group-based delivery enhanced accessibility. However, inconsistency in outcome measures and long-term follow-up remain significant limitations.

CONCLUSIONS: Findings indicate that neuropsychological interventions should be central to PMS care, given their alignment with the needs of people with PMS, focusing on preserving function and quality of life.

126. Using Virtual Reality to Detect Cognitive Fatigability in Daily-Life Tasks for People With Multiple Sclerosis: A Feasibility Study

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Abstract

INTRODUCTION: Cognitive fatigability (CF)–measurable performance decline over time during cognitive tasks may help explain subtle cognitive alterations experienced by people with multiple sclerosis (MS). Existing neuropsychological assessments may not sufficiently reflect how CF unfolds during everyday activities. A longer-duration measurement with ecologically valid tasks is needed, as is knowledge of the physiological correlates of CF.

METHOD: This prospective study examined the feasibility of a novel test protocol. Women (18-55 years) with relapsing-remitting MS completed a fatigue-inducing protocol of a 15-minute virtual reality shopping task. Changes over time between segments at 5 (T1), 10 (T2), and 15 minutes (T3) in behavioral (reaction time, accuracy) and physiological (heart rate variability) variables were measured. Self-reported momentary cognitive fatigability was scored using a visual analog scale (VAS).

RESULTS: Preliminary results in 10 participants (45.2 ± 9.1 years; Expanded Disability Status Scale score 2.8) showed significant improvements over time in task performance for accuracy ($F = 7.051$, $P = .005$) and reaction time ($X^2(2) = 8.600$, $P = .014$). At T3, moderate-strong correlations between VAS and accuracy (0.69, $P = .03$) and between VAS and reaction time (–0.72, $P = .018$) were found. With a mean NASA Task Load Index score of 45.2 (± 12.3), the protocol seemed demanding without being excessively burdensome. The physiological measurements have not been processed.

CONCLUSIONS: These preliminary results suggest that the fatigue-inducing protocol is well tolerated and feasible. Although participants reported increasing levels of CF during the task, no clear pattern of CF in the behavioral responses emerged. Improved accuracy and faster reaction times during task progression suggest learning effects in performance, requiring further research.

Rehabilitation of Communication and Swallowing in Multiple Sclerosis and Related Disorders

This chapter focuses on restorative and compensatory rehabilitation for communication, swallowing, and fatigue—3 pillars of daily functioning for individuals with multiple sclerosis. Maintaining clear communication is vital for patient advocacy and social connection, while safe swallowing ensures proper nutrition and prevents complications like pneumonia. Further, because fatigue can hinder all aspects of recovery, mastering energy conservation is crucial for sustaining activity and managing symptom severity.

76. Exploring the Clinical Utility of DYMUS and EAT-10 in Speech Therapy for Oropharyngeal Dysphagia in Multiple Sclerosis: A Pilot Study

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Abstract

INTRODUCTION: People with multiple sclerosis (PwMS) may develop oropharyngeal dysphagia (OD), significantly affecting quality of life and causing psychosocial impact.

OBJECTIVES: To evaluate the effect of structured speech therapy on OD in PwMS using the Dysphagia in Multiple Sclerosis Questionnaire (DYMUS) and the Eating Assessment Tool-10 (EAT-10).

METHODS: A pre/post pilot study was conducted with 12 participants (66.7% women; mean age 50.5 years; mean Expanded Disability Status Scale [EDSS] score 5), predominantly with secondary progressive MS. Dysphagia severity was assessed using DYMUS and EAT-10 at baseline (T1) and postintervention (T2). The intervention consisted of 16 weekly 30-minute speech therapy sessions targeting swallowing function.

RESULTS: No statistically significant changes were observed in DYMUS or EAT-10 scores at the group level. The prevalence of dysphagia for solids remained stable. According to EAT-10, 4 participants improved, 1 remained stable, and 7 worsened. However, clinically relevant individual changes were observed: One participant improved from moderate to mild dysphagia, and another shifted from mixed dysphagia to liquid-only dysphagia.

CONCLUSIONS: Although no statistically significant changes were detected at the group level, clinically meaningful improvements in individual cases suggest speech therapy may have a beneficial role in selected PwMS with dysphagia. These findings highlight the potential contribution of speech therapy within multidisciplinary rehabilitation approaches. However, small sample size and the absence of instrumental assessments (eg, Volume-Viscosity Clinical Exploration Method, videofluoroscopy) limit interpretation and external validity of the results. Future research should include larger, more diverse samples in terms of age, sex, and EDSS, as well as objective swallowing assessments, to better characterize treatment effects.

Technology-Enhanced Rehabilitation in Multiple Sclerosis and Related Disorders

This chapter highlights how technologies such as robotics, virtual reality, telerehabilitation, and artificial intelligence can enable high-intensity, personalized interventions while supporting monitoring and biomarker identification. Aligned with the conference's focus, it addresses a central challenge in multiple sclerosis rehabilitation: balancing recovery and compensation in a clinically meaningful way. Further, it reinforces RiMS' commitment to multidisciplinary, innovation-driven, and patient-centered care, ultimately supporting more adaptive pathways to improve participation, autonomy, and quality of life.

2. Smoking Cessation Intervention for People With Multiple Sclerosis: Results of a Feasibility Study

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Abstract

BACKGROUND: Smoking accelerates disease progression in people with MS (PwMS). To address this risk factor, we designed and evaluated an MS-specific smoking cessation program.

METHODS: The intervention consisted of 5 group sessions over 3 weeks and was based on a generic smoking cessation program (Rauchfrei Programm) utilizing aspects of cognitive behavioral therapy. The program was led by certified trainers and included MS-specific content throughout. Feasibility outcomes, including adherence, acceptability, and participant feedback, were assessed 3 weeks post intervention. Smoking cessation was evaluated at 3 and 12 weeks post intervention. Recruitment took place via our own institution and MS centers and clinics across Germany, as well as online.

RESULTS: Between November 2024 and May 2025, we screened 130 individuals, with 99 found to be eligible. Of the 48 PwMS who started the intervention, 40 (83%) completed the 3-week follow-up, and 37 (77%) the 12-week follow-up. All participants who completed the acceptability questionnaire (n = 39) (3-week follow-up) stated that they would recommend the program to other pwMS, indicating strong acceptability. Quit rates were 48% (n = 23) after 3 weeks and 25% (n = 12) after 12 weeks.

CONCLUSIONS: Results show high adherence, acceptability, and promising quit rates for the newly developed smoking cessation intervention for PwMS. Future research should focus on the implementation of this program as part of standard care, while continuing to monitor participant feedback and quit rates. The findings further suggest that this tailored approach might be a promising way to adapt existing smoking cessation programs to other patient groups with chronic or neurological conditions.

4. Exopulse Mollii Suit Improves Balance and Mobility, Reduces Spasticity and Enhances Quality of Life: A Randomized Controlled Trial in Multiple Sclerosis

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Abstract

BACKGROUND: People with multiple sclerosis (MS) can experience reduced mobility, spasticity, pain, fatigue, and altered quality of life. The available therapeutic strategies leave them with unmet needs, but nonpharmacological therapies, such as transcutaneous electrical nerve stimulation (TENS), may constitute an additional promising intervention. Unlike conventional TENS devices with a limited number of electrodes, the Exopulse Mollii Suit consists of a jacket and pants that enable simultaneous stimulation of 40 muscle groups, thereby addressing the diffuse topography of symptoms.

METHODS: The current study consisted of 2 phases: a randomized, sham-controlled, double-blind, crossover trial during which every participant underwent a single 1-hour session of active or sham stimulation using the Exopulse Mollii Suit (washout interval: 2 weeks), and a second open-label period during which the sessions were repeated every other day for 4 weeks. Thirty-two adult patients with MS-related spasticity were included and evaluated before and after each phase. Phase 1 and 2 outcomes consisted of balance (primary outcome), spasticity, mobility, fatigue, and pain. Quality of life and additional outcomes were assessed in phase 2.

RESULTS: Compared to sham, a single session of active intervention led to significant effects on balance, spasticity, and fatigue during phase 1 ($P < .05$). Following the repetition of stimulation sessions during phase 2, sustained and/or emerging effects were significantly observed with regard to balance, mobility, spasticity, and quality of life ($P < .05$).

CONCLUSIONS: Using the Exopulse Mollii Suit appears to yield beneficial clinical effects in people with MS, and repeating the stimulation seems to optimize these benefits.

12. Quantitative Assessment of the Efficacy of an Innovative AI-Driven Telerehabilitation Protocol

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Abstract

Physical rehabilitation has been shown to be effective in improving motor function in people with multiple sclerosis (PwMS), but symptom burden, health care constraints, and geographic distance from specialized centers can limit access to dedicated programs. Telerehabilitation has the potential to allow PwMS to perform unsupervised exercises at home using personal devices. However, since there is limited evidence of the actual effectiveness of such an approach, we employed 3D gait analysis to assess an innovative telerehabilitation platform, Wizecare, designed to deliver personalized exercise programs and provide real-time feedback on movement features through artificial intelligence–based algorithms.

Thirteen PwMS (Expanded Disability Status Scale score range, 2.0-6.5) completed a short-term exercise program delivered through the telerehabilitation system, consisting of eight 45-minute sessions performed twice weekly. Spatiotemporal parameters and sagittal kinematics at the hip, knee, and ankle during gait were assessed at baseline and after the intervention using 3D gait analysis. Interlimb and intralimb coordination were also assessed using angle-angle diagrams (cyclograms).

The results show a significant (and clinically meaningful) increase in gait speed (+0.15m/s) originated by a concurrent increase in stride length and cadence. The dynamic range of motion improved at the hip, knee, and ankle joints. We also detected an improvement of intralimb symmetry, as indicated by larger knee-ankle and hip-knee cyclogram areas.

Overall, the intervention demonstrated a clear efficacy in terms of improved spatiotemporal parameters and joint kinematics, resulting in gait patterns closer to the physiologic conditions. These findings highlight the potential of the Wizecare platform as a tool for remotely delivered rehabilitation for PwMS.

19. Do People With Multiple Sclerosis Accept Humanoid Social Robots? Insights from a Human-Robot Interaction Study

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Abstract

BACKGROUND: Social robots (SRs) are increasingly integrated into daily life, with applications spanning education, industry, culture, and health care. Despite their potential across sensory-motor, cognitive, and affective domains, their use by people with multiple sclerosis (PwMS) remains largely unexplored.

OBJECTIVES: To evaluate the usability of an SR in PwMS, compare experiences with age-matched healthy controls (HCs), identify predictors of usability, and explore whether language reflects robot appraisal.

METHODS: PwMS and HCs completed 4 tasks with the humanoid robot Pepper (SoftBank Robotics). Usability was evaluated with the System Usability Scale (SUS). Additional measures included attitudes toward robots (General Attitudes Towards Robots Scale [GAToRS]), robot-related factors (Godspeed Questionnaire Series), task effort (NASA-Task Load Index), personality traits (Ten-Item Personality Inventory [I-TIPI]), cognition (Digital Assessment of Cognitive Impairment in Multiple Sclerosis [DIGICOG-MS]), and upper-limb difficulties (Arm Function in Multiple Sclerosis Questionnaire). Language from semistructured interviews was analyzed using Natural Language Processing (NLP).

RESULTS: SUS scores were high and comparable across groups (PwMS M = 81.0; HCs M = 77.8; P = .389). PwMS reported more negative societal-level robot attitudes (GAToRS: P = .023) and perceived Pepper as more anthropomorphic and intelligent (Godspeed anthropomorphism: P =.007; intelligence: P = .023). Visuospatial (ρ = –0.632; P = .003) and verbal (ρ = –0.504; P =.023) memory via DIGICOG-MS, and agreeableness from I-TIPI (ρ = 0.491; P =.028) correlated with anthropomorphism. Exploratory stepwise regressions indicated that conscientiousness, robot attitudes, and upper-limb deficits explained 64% of SUS variance, whereas task frustration explained 48%. NLP analyses revealed no between-group differences, with both PwMS and HCs exhibiting a positive emotional tone.

CONCLUSIONS: This study provides the first empirical evidence of SR usability in PwMS. Psychological aspects, functional abilities, and prior attitudes shape user experience. Integrating clinical, psychological, and language measures may support tailored interventions with SRs in PwMS.

27. AI-Based Telerehabilitation for Multiple Sclerosis: Feasibility and Usability in a Multicenter Pilot Study

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Abstract

Telerehabilitation has emerged as a promising approach to improve access to exercise-based rehabilitation for people with multiple sclerosis (PwMS). However, many existing systems remain limited by their complexity, reliance on additional hardware, and lack of real-time feedback on exercise performance. Artificial intelligence (AI)–based platforms may help overcome these barriers by enabling accurate movement tracking and feedback using standard consumer devices. This prospective, multicenter, single-arm pilot study aimed to evaluate the feasibility and usability of an AI-based telerehabilitation system in pwMS across multiple international sites.

Thirty-four PwMS were enrolled in a 4-week telerehabilitation program of 8 sessions, including both standard and AI-supported (MoveAI) exercises. Primary outcomes included recruitment, retention, adherence, and compliance. Usability was assessed using the Telehealth Usability Questionnaire (TUQ) and semistructured interviews. Exploratory mobility outcomes were assessed at baseline and after the intervention.

Retention was high with a low dropout rate (5.8%). Adherence was greater for MoveAI exercises (68.3% with a compliance of 70.7%) compared with standard exercises (48.4%). Usability was rated positively (mean TUQ score: 86.8), supported by qualitative findings indicating good acceptability, perceived benefits, and ease of use. Reported challenges included technical issues related to camera positioning and movement recognition. Exploratory analyses demonstrated significant improvements in mobility outcomes, including gait performance (Timed 25-Foot Walk test), balance (Mini-Balance Evaluation Systems Test), and patient-reported walking ability (12-Item Multiple Sclerosis Walking Scale).

The AI-based telerehabilitation system showed good feasibility and usability in PwMS, with higher adherence to AI-supported exercises. These findings highlight its potential to improve engagement and accessibility in rehabilitation, warranting further evaluation in a multicenter randomized controlled trial.

31. Integrating Rehabilitation Into the Electronic Health Record in Multiple Sclerosis: The Smart FSE Multicenter Initiative

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Abstract

BACKGROUND: Multiple sclerosis (MS) treatment requires coordinated, multidisciplinary efforts. However, rehabilitation data are often fragmented and poorly integrated within health care systems, limiting continuity of care and reducing their value for clinical decision-making and research. The Italian Electronic Health Record (EHR 2.0) offers a unique opportunity to address these gaps, although structured integration of rehabilitation data remains limited.

OBJECTIVES: To implement and evaluate a multicenter model integrating rehabilitation data into the national EHR, improving clinical care pathways, patient engagement, and research capacity in MS.

METHODS: Smart FSE is an add-on module of the national SMART REHAB-MS platform, implemented across Italian Multiple Sclerosis Society rehabilitation services and coordinated by the NeuroBRITE Research Center (Genoa). The project involves a multidisciplinary network of health care professionals and data scientists. Rehabilitation data (functional outcomes, patient-reported outcomes, and care processes) are standardized and integrated into the EHR using national interoperability standards. The implementation will follow 4 phases: pilot validation, rollout, evaluation, and optimization. Key performance indicators include care continuity, data completeness, and patient engagement.

RESULTS: The initiative is expected to involve over 2850 people with MS and more than 150 health care professionals. Preliminary outcomes include improved accessibility of rehabilitation information within care pathways, enhanced multidisciplinary coordination, and increased patient participation. The system enables the generation of longitudinal real-world data sets supporting outcome evaluation and predictive modeling in rehabilitation.

CONCLUSIONS: Smart FSE provides a scalable framework to embed rehabilitation within digital health infrastructures, strengthening the role of MS centers as integrated clinical and research hubs.

39. Implementing a Digital Platform to Support an Inpatient Rehabilitation Service

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Abstract

The digital era and the demand for more cost-effective health care services challenge the traditional delivery of inpatient rehabilitation in Norway. Improving efficiency in administrative tasks—such as scheduling appointments, collecting outcome measures, and documenting in electronic medical records—may free valuable time for direct patient care. To address these challenges, MS-Senteret Hakadal has implemented a digital platform to enhance communication, coordination, and patient engagement throughout the rehabilitation process.

The application (app) was implemented gradually to ensure sufficient digital competence among clinicians and to support a clear, understandable, and safe user experience for patients. This stepwise approach enabled continuous learning, reduced the threshold for digital adoption, and supported a stable, well-integrated transition from paper-based to digital processes.

The app supports key phases of the patient journey, including preadmission preparation, individualized information during the rehabilitation stay, and access to the rehabilitation plan after returning home. It includes modules for digital self-reporting, intervention planning, and secure communication with the interdisciplinary team. For clinicians, the app increases efficiency by supporting documentation through an artificial intelligence–generated speech-to-text function.

Patient feedback indicates an easy-to-use app, with a clear preference for the digital calendar over the former paper version and for receiving written information in the app rather than on paper. No negative feedback was reported regarding the use, although some noted minor distress in being more dependent on the mobile phone.

Further implementation will expand to integrating long-term follow-up rehabilitation plans.

54. A Technological System for the Assessment of Motor and Cognitive Functions During Activities of Daily Living in People With Multiple Sclerosis

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Abstract

BACKGROUND: People with multiple sclerosis (PwMS) experience difficulties in activities of daily living (ADL). Recent technological advances enable the monitoring of motor and cognitive functions in real-world settings, providing objective and continuous assessments. This study evaluates AI-MOKa, a system that integrates wearable sensors and artificial intelligence algorithms to measure motor and cognitive abilities during ADL in PwMS and healthy controls (HCs).

METHODS: Participants performed a coffee-making task derived from the Assessment of Motor and Process Skills tool while wearing Tobii eye-tracking glasses and insoles with Pedar sensors. Metrics collected included pupil diameter (as an index of cognitive load), time spent in different areas, task duration, number of steps, cadence, and weight distribution. Data were compared between PwMS and HCs.

RESULTS: Twenty PwMS (age [M ± SD]: 55 ± 11 years; 12 women, 8 men; disease duration [M ± SD]: 15 ± 6 years; 15 relapsing-remitting MS, 1 primary progressive MS, 5 secondary progressive MS; Expanded Disability Status Scale score [M ± SD]: 2.8 ± 1.39) and 20 healthy controls (age [M ± SD]: 47 ± 15 years; 9 men, 11 women) were included. Significant differences ($P < .1$) between groups were observed in maximum pupil diameter (left and right), resting pupil diameter, and time spent in the coffee area (lower in PwMS), as well as mean minimum pupil diameter and time spent in the living area (lower in HCs). No differences were observed in motor parameters.

CONCLUSIONS: PwMS appear to organize the activity differently and show reduced modulation of cognitive load compared with HCs. AI-MOKa may therefore represent an innovative approach for the objective and continuous assessment of ADL in real-life contexts.

57. A Multimodal Digital Lifestyle Intervention in People With Multiple Sclerosis: Is It All About the Money? A Cost-Effectiveness Evaluation

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Abstract

INTRODUCTION: Despite advances in disease-modifying therapies, multiple sclerosis (MS) remains associated with irreversible disability progression, persistent symptom burden, and productivity losses, contributing to high societal costs. Lifestyle interventions may improve outcomes, but their economic value remains unclear.

OBJECTIVES: To evaluate the economic impact of a multimodal lifestyle intervention in MS by (1) assessing 24-month societal costs and health-related quality of life (HRQoL) trajectories and (2) conducting a 3-month exploratory cost-effectiveness analysis within the Lifestyle Intervention in MS (LIMS) study.

METHODS: Societal costs (health care use, informal care, productivity losses) and HRQoL were assessed. Longitudinal trajectories over 24 months were analyzed using linear mixed-effects models. An exploratory cost-effectiveness analysis compared the 3-month intervention period with a within-participant preintervention (run-in) period.

RESULTS: Six hundred sixty-five people with MS participated (mean age 46.1 ± 10.8 years; 85% female; disease duration 7.2 [2.5-13.8] years). Total societal costs decreased during the intervention period (cost ratio, 0.87; 95% CI, 0.76-1.00) and further declined during the follow-up period (cost ratio, 0.70; 95% CI, 0.61-0.82). The exploratory cost-effectiveness analysis indicated that the LIMS program dominated usual care from societal and employer perspectives, reflecting lower costs (Δ€-546 and Δ€-548) alongside modest improvements in HRQoL (Δ0.002). From the health care perspective, the intervention was associated with higher costs (Δ€187) and improved HRQoL (Δ0.002), indicating a cost-effectiveness trade-off.

CONCLUSIONS: The multimodal LIMS intervention was associated with reductions in societal costs and modest improvements in HRQoL, suggesting that lifestyle-based approaches may represent a potentially cost-efficient complement to conventional MS care.

63. BrainMotionMS: A Digital Dual-Task Rehabilitation Application for People With Multiple Sclerosis: User Experience

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Abstract

INTRODUCTION: Multiple sclerosis (MS) is associated with motor and cognitive impairments that affect gait and activities of daily living. Dual-task (DT) rehabilitation is recommended but remains difficult to access in routine clinical practice. Home-based digital solutions represent an innovative approach to improving accessibility and adherence to care. BrainMotionMS is a mobile application dedicated to DT rehabilitation in people with multiple sclerosis (pwMS). This study aimed to assess its feasibility.

METHODS: A focus group study was conducted with 9 pwMS (7 women, 2 men) with mild to moderate disability (Expanded Disability Status Scale score range, 0-5). Participants used BrainMotionMS independently at home for 2 weeks (4 DT rehabilitation sessions/wk, 20 min/session). Evaluation was based on a satisfaction questionnaire, usability assessment (System Usability Scale), and subjective (cognitive) workload assessment (NASA-Task Load Index). DT difficulty was assessed using a Likert scale.

RESULTS: Installation and initial use were considered easy by 94% of pwMS. Understanding of the motor and cognitive instructions was considered clear by 94% of pwMS. Usability was excellent (mean = 93.5 ± 7.4). Perceived DT difficulty was moderate (mean = 3 ± 1.3). The application was considered motivating by 100% of participants and perfectly suited to daily needs by 75%. Adherence to the prescribed session schedule was 91.7%.

DISCUSSION: BrainMotionMS appears feasible, well accepted, and relevant for independent home use in pwMS. These preliminary findings suggest that the application represents an appropriate preliminary step before conducting a multicenter study aimed at evaluating its clinical effectiveness.

66. An IMU-Based Approach to Assess Inter- and Intralimb Coordination During the 6-Minute Walking Test in People With Multiple Sclerosis

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Abstract

Although the 6-Minute Walk Test (6MWT) is a reliable and ecologically valid measure of functional exercise capacity in people with multiple sclerosis (PwMS), kinematic adaptations during the test remain poorly understood. This study employed a wearable motion capture system to assess sagittal kinematics of the hip, knee, and ankle, analyzing inter- and intralimb coordination throughout the test.

Sixty-five PwMS (Expanded Disability Status Scale score range, 0-6.5) and 51 individuals without MS performed a 6MWT while wearing an 8-sensor inertial measurement system. Lower limb kinematics were evaluated minute-by-minute using accelerations and angular velocities recorded from the trunk and lower limbs. Interlimb coordination was quantified using angle-angle diagrams (cyclograms) and the Phase Coordination Index (PCI), while intralimb coordination was assessed via cyclogram area for hip-knee and knee-ankle joint pairs.

PwMS exhibited significantly higher PCI values than controls, with PCI increasing linearly in both groups. However, by minute 6, the increase was greater in controls (+32%, $P = .001$) compared to PwMS (+12%, not significant). Similar linear trends of increase were observed for interlimb joint cyclograms; however, controls showed larger increases over time, whereas PwMS presented greater cyclogram areas at minute 1. A significant and comparable reduction in knee-ankle coordination was observed in both groups.

These findings confirm impaired inter- and intralimb coordination in PwMS and show that fatigue during the 6MWT worsens coordination in both groups. Notably, the magnitude of deterioration was often smaller in PwMS. Further research is needed to clarify the influence of fatigability and disability level on these adaptations.

75. The Gestus Project: Automated Outdoor Motion Capture for Neurorehabilitation With Wearable GNSS–IMU Sensors

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Abstract

Assessing motor performance in ecologically valid settings is increasingly important in neurorehabilitation, as outdoor rehabilitation may enhance engagement and better reflect patients' functional abilities in daily life. In this context, quantitative movement analysis plays a key role in evaluating the severity of motor impairments and monitoring rehabilitation progress, allowing clinicians to make informed decisions based on objective measurements.

Laboratory motion capture systems are widely used to record human movement with high accuracy and quantify rehabilitation outcomes. However, these systems typically rely on optical infrastructure and controlled environments, which limit their use in outdoor or large-scale environments. Wearable sensing technologies, such as inertial measurement units (IMUs), offer a portable alternative but have limitations, including orientation drift over time and an inability to reliably reconstruct the body's global translation. Furthermore, many motion analysis workflows require multiple manual processing steps and specialized software tools, which may limit their adoption in clinical settings.

To address these limitations, the Gestus Project proposes an automated cloud-based pipeline for outdoor human motion analysis using wearable sensors equipped with Global Navigation Satellite System (GNSS) receivers and IMUs. The system integrates wearable sensing hardware with automated cloud processing to reconstruct human motion while minimizing user intervention. GNSS and IMU data are combined to extract clinically relevant gait parameters. By enabling objective motion analysis in natural environments while reducing user intervention, this approach may support more scalable and ecologically valid assessment and monitoring of gait and mobility for neurorehabilitation applications.

81. Distinct Cognitive-Motor Prioritization Strategies in Multiple Sclerosis: A Dual-Task Cost Clustering Approach

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Abstract

Cognitive-motor interference is common in people with multiple sclerosis (PwMS). Dual-task cost (DTC) can provide insight into task prioritization; however, existing evidence remains inconsistent. In this study, we explored the presence of cognitive-motor phenotypes in PwMS using clustering techniques.

Sixty-one PwMS (38 women; age = 51.3 ± 12.1; Expanded Disability Status Scale score = 2.71 ± 1.33; Hospital Anxiety and Depression Scale = 13.43 ± 8.62; Symbol Digit Modalities Test = 50.33 ± 15.01; Timed Up and Go = 9.28 ± 3.83) performed motor single tasks (simple walking [SW] and complex walking [CW] while holding a cup) and cognitive single tasks (Digit Span Backward [DSB]; Serial Subtraction by 7 [By7], clock task [CT]; Word List Generation Semantic [WLGS]). Participants also performed combined cognitive-motor dual tasks (DT) (SW-DSB, SW-By7, SW-CT, SW-WLGS; CW-DSB, CW-By7, CW-CT, CW-WLGS). For each DT, motor and cognitive DTC were calculated, and hierarchical clustering was applied.

Three clusters have been identified; a single case was excluded from the analysis. Cluster 1 (n = 17) included PwMS who prioritized motor tasks, primarily during DSB and By7 cognitive conditions. Clusters 2 (n = 20) and 3 (n = 23) included PwMS who prioritized cognitive tasks, mainly during WLGS and CT, or By7, respectively. Demographic and clinical characteristics did not differentiate clusters, whereas poorer cognitive single-task performance appeared to drive cognition-first prioritization strategies. Moreover, distinct patterns of association between DT performance and mood, cognitive, and motor function were observed across clusters.

DTC-based clustering may help identify subgroups of PwMS with distinct prioritization strategies during DT. Cognition-first strategies adopted by individuals with poorer cognitive single-task performance may increase the risk of postural instability or falls and could be targeted through personalized rehabilitation interventions.

88. Innovative Virtual Reality Software Implementing Principles of Neurophysiological Rehabilitation Improves Upper-Limb Function and Quality of Life in People With Multiple Sclerosis

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Abstract

INTRODUCTION: Virtual reality (VR) is a promising tool in the physiotherapy of people with multiple sclerosis (PwMS), offering a motivating therapeutic environment.

OBJECTIVE: To evaluate the effectiveness of tailored immersive VR physiotherapy utilizing neuroproprioceptive facilitation and inhibition on upper-limb function and quality of life in PwMS.

METHODS: In this randomized controlled trial, participants were offered an 8-week rehabilitation program (a total of 15 hours, twice weekly). The intervention group received VR-based therapeutic software integrating proprioceptive neuromuscular facilitation and motor program activating therapy with a physiotherapist actively optimizing movement. The control group followed an identical program without VR. Outcomes included the 9-Hole Peg Test (NHPT) and the Multiple Sclerosis Impact Scale (MSIS-29), analyzed using a 2-way repeated-measures analysis of variance for group, time, and their interaction.

RESULTS: Both groups improved fine motor function in the NHPT for the dominant hand, with significantly greater improvement in the control group (P=.013). For the nondominant hand, improvements were comparable between groups (P<.001 for time; P=.449 for interaction). Quality of life improved over time across total MSIS-29 scores and both physical and psychological subscales (P<.001; P<.001; P=.017, respectively) with no significant between-group differences.

CONCLUSIONS: Both physiotherapy approaches improved upper-limb function and quality of life. VR is an engaging therapeutic tool that can be used while preserving the physiotherapist's role. Larger randomized studies are needed to confirm noninferiority or superiority.

Study supported by Charles University, project GA UK no. 202322 and by the Ministry of Health of the Czech Republic, grant no. NW26-09-00096.

94. Development of a Machine Learning Model to Detect High-Risk Near-Falls During Volitional Step Training in People With Multiple Sclerosis

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Abstract

Falls are a major health concern in people with multiple sclerosis (PwMS). Although exercise-based interventions have been shown to improve balance, their effectiveness in reducing falls remained inconclusive due to insufficient training dose and inadequate exercise challenge, especially in individuals with higher disability. Mixed reality (MR) was proposed as a promising solution to enable individualized, adaptive, and home-based volitional step training. A key component for safe implementation was the detection of near-falls during training, defined as loss-of-balance events that require compensatory responses.

This observational longitudinal study aimed to develop a machine learning algorithm to detect high-risk near-falls during volitional step tasks in PwMS. Fifteen PwMS performed volitional step training guided by auditory and visual cues. Head-mounted inertial measurement unit (IMU) data were collected during the tasks. Near-falls were identified from video recordings by blinded raters and classified based on compensatory postural adjustments into high- or acceptable-risk categories. A convolutional neural network (CNN) was trained using IMU signals to automatically detect high-risk events.

Preliminary data from 49 assessments in 18 PwMS (Expanded Disability Status Scale score, 5.5 ± 1.03; age, 53.7 ± 1; 78% female) identified 239 near-fall events, of which 49 were classified as high risk. Preliminary results from model training showed an accuracy rate of more than 90% in the agreement between near-fall events identified by the CNN and those identified by the physiotherapist.

These findings support the feasibility of identifying high-risk near-falls using wearable sensor data. Integrating such algorithms into MR systems could enable the closed-loop real-time adaptation of exercise difficulty, ensuring both safety and sufficient challenge.

95. Intermittent Negative Pressure Reduces Spinal Excitability in Multiple Sclerosis: Neurophysiological Evidence from Soleus H-Reflex Modulation

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Abstract

INTRODUCTION: Spasticity is a common and disabling symptom in people with multiple sclerosis (PwMS). Intermittent negative pressure (INP) therapy delivered via the FlowOx (Conformité Européenne–marked medical device) has recently been proposed as a nonpharmacological intervention to improve peripheral circulation, with preliminary evidence showing reductions in self-reported spasticity, pain, and sleep disturbances among PwMS. However, the neurophysiological mechanisms underlying these beneficial effects remain unclear, particularly whether INP can modulate spinal reflex excitability, which is usually high in patients with spasticity.

OBJECTIVE: To investigate the acute effects of a single session of INP delivered by FlowOx on spinal excitability in PwMS with spasticity, assessed through the soleus H-reflex.

METHODS: Twenty PwMS with spasticity (11 men, 9 women; age [mean ± SD]:49 ± 9 years; Body Mass Index [kg/m^2]: 22.6 ± 1.7; Expanded Disability Status Scale score: 5 ± 1.5; visual analog scale: 5.1 ± 1; Modified Ashworth Scale: 4 ± 0.5) participated in a single experimental session. INP was applied to the lower limb using FlowOx for 1 hour. Soleus H-reflex recruitment curves were recorded before treatment (PRE), immediately after INP (POST), and 20 minutes after treatment (POST-20). The Hmax/Mmax ratio was calculated as an index of spinal excitability.

RESULTS: The SOL Hmax/Mmax ratio significantly decreased by 13.9% at POST (P = .001) and remained reduced at POST-20 (−13.7%, P = .001) compared with PRE values. No significant differences were observed between POST and POST-20 (P = .995).

CONCLUSIONS: The acute decrease in Hmax/Mmax ratio suggests a modulation of Ia-mediated spinal reflex pathways. These findings provide preliminary neurophysiological evidence that INP-based technologies may influence sensorimotor spinal circuitry, supporting their potential role as adjunct tools in technology-enhanced rehabilitation for PwMS.

101. The Effect of Unsupervised Home-Based Balance Exercise vs Individual Physiotherapy

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Abstract

INTRODUCTION: Balance disturbance occurs quite frequently in people with multiple sclerosis (PwMS) and is subjectively rated by them as one of their most unpleasant symptoms. Poor balance limits mobility and functional self-sufficiency, leads to falls and injuries, and negatively affects quality of life.

METHODS: A group of PwMS was randomly assigned to an individual, unsupervised home-based exercise group using the HomeBalance stability platform or an individual physiotherapy group using sensorimotor training. The effect of the 4-week balance therapy was evaluated using the following standardized methods: the Berg Balance Scale, the Mini Balance Evaluation Systems Test (MiniBESTest), the Timed Up-and-Go, the Timed 25-Foot Walk Test, and the 1-leg stand. The subjectively perceived effect was assessed using standard questionnaires: the MS Walking Scale-12 and the Falls Efficacy Scale. Due to the nonnormal distribution of data, nonparametric tests in SPSS (IBM) were used for evaluation.

RESULTS: A total of 39 PwMS participated in the study. Participants were randomly assigned to home-based exercise (n = 20) and individual physiotherapy (n = 19). When comparing the effect between the 2 groups, no statistically significant difference was found. A statistically significant difference was found in both groups in the Berg Balance Scale test (P = .005 vs .001) and the MiniBESTest (P = .014 vs P < .000).

CONCLUSIONS: Home balance training on a stability platform with biofeedback has a comparable effect on improving balance with individual physiotherapy.

103. Smart Light, Slow Response: Assessing Upper Extremity Reaction Time in People With Multiple Sclerosis Using BlazePod: A Technology-Based Preliminary Study

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Abstract

OBJECTIVE: Multiple sclerosis (MS) is characterized by demyelination, disrupting neural transmission and impairing functions such as manual dexterity and cognition. This study aimed to evaluate upper extremity (UE) reaction time in people with MS (PwMS) using the BlazePod Reaction Test, integrating cognitive processing with functional UE activity.

METHODS: A total of 15 PwMS and 15 age- and sex-matched healthy controls (HC) were included. UE reaction time was assessed using the BlazePod system (Play Coyotta Ltd), which utilizes wireless light-emitting diode sensors to combine assessment of cognitive and physical performance. The test was conducted in a seated position using 4 pods over 30 seconds in 2 modes: BlazePod Random Test (BPRT) and BlazePod Focus Test (BPFT). Participants tapped blue-lit pods as quickly as possible; reaction time and total hits were recorded. Additional assessments included the 9-Hole Peg Test (NHPT), 15-White Dots Task (15-WDT), lateral grip strength (LGS), and Symbol Digit Modalities Test (SDMT).

RESULTS: PwMS showed significantly worse performance than HC in BPRT reaction time and hits ($P < .001$), BPFT reaction time ($P < .001$), NHPT ($P < .001$-$.003$), 15-WDT ($P = .009$), LGS ($P = .035$), and SDMT ($P < .001$). No significant between-group difference was found in BPFT hits ($P = .098$), although results favored HC. Overall, PwMS demonstrated slower reaction times.

CONCLUSIONS: Based on our findings, reaction time is impaired in PwMS from the early stages of the disease. BlazePod appears to be a user-friendly system to monitor impairments in UE function and information processing speed. It may also be used in rehabilitation, potentially improving physical and cognitive function in PwMS.

107. Use of the Exopulse Mollii Suit in People With Multiple Sclerosis: Effects on Upper and Lower Limb Function

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Abstract

BACKGROUND: The Exopulse Mollii Suit is a wearable neuromodulation device delivering low-frequency electrical stimulation via 58 integrated electrodes. It targets 40 key muscle groups through subthreshold impulses, promoting relaxation of spastic muscles and improving motor function. Its use in people with multiple sclerosis (PwMS) is increasing, but evidence on its effects on upper and lower limbs remains limited.

OBJECTIVES: To evaluate the effects of the Mollii Suit on motor performance and functional outcomes in both lower and upper limbs in PwMS.

METHODS: Fifteen PwMS (Expanded Disability Status Scale score range, 3.5-4.5) were enrolled; 6 completed the intervention. Participants were assessed at baseline (T0), 1 week (T1), and 8 weeks (T2) postintervention. The intervention consisted of 10 sessions, each lasting 90 minutes. Lower limb assessments included the 6-Minute Walk Test, 10-Meter Walk Test, Timed Up-and-Go, and Berg Balance Scale. Upper limb assessments included 9-Hole Peg Test, Box and Block Test, handgrip strength, and Jebsen-Taylor Hand Function Test. Quality of life, fatigue, pain, and spasticity were measured using the Disabilities of the Arm, Shoulder and Hand questionnaire; the Modified Fatigue Impact Scale; and validated pain and spasticity scales.

RESULTS: At T1, participants improved in balance, endurance, mobility, and upper limb dexterity and motor function, particularly on the more affected side. Pain and spasticity perception also improved. At T2, outcomes slightly declined but remained above baseline.

CONCLUSIONS: The Exopulse Mollii Suit is a promising noninvasive adjunct to rehabilitation for PwMS, enhancing limb function, motor control, and symptom management. These preliminary results support further research with larger samples to confirm efficacy and optimize treatment protocols.

109. Feasibility of Intensive Visual Stimulation for Upper Limb Rehabilitation in Multiple Sclerosis

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Abstract

Upper limb impairment is a common and disabling symptom for people with multiple sclerosis (PwMS), significantly affecting performance in meaningful activities of daily living (ADL). Rehabilitation approaches have shown increasing potential in improving upper limb function. This pilot study aimed to evaluate the feasibility and preliminary effectiveness of an artificial intelligence–based, computer-guided intensive visual stimulation (IVS3) intervention for enhancing upper limb function in PwMS.

Ten consecutive PwMS were referred to occupational therapy (OT) (mean age, 56.7 ± 10.9 years; 70% female; Expanded Disability Status Scale score, 4.05 ± 1.81). Disease phenotypes included primary progressive (40%), secondary progressive (30%), and relapsing-remitting (30%) forms. Participants completed 20 outpatient OT sessions integrating IVS3 with standard OT counseling. Each session lasted 60 minutes. Fine motor function and dexterity were assessed with the 9-Hole Peg Test (NHPT) and the NHPT with cognitive interference (NHPT&CI). Self-perceived performance and satisfaction in meaningful ADL were evaluated using the Canadian Occupational Performance Measure (COPM). Assessments were conducted at baseline and post-intervention.

Statistically significant improvements ($P < .05$) were observed across all outcome measures. Participants demonstrated improved manual dexterity in both dominant and nondominant hands, reflected by enhanced NHPT and NHPT&CI performance. Additionally, COPM performance and satisfaction scores indicated improved self-perceived ADL performance. Paired-samples *t* tests were used to analyze differences between measurements (IBM SPSS Statistics, version 31).

These findings suggest that IVS3 is a feasible and potentially effective adjunct to occupational therapy for improving upper limb function and self-perceived ADL performance in PwMS.

113. Perceptive Sensitivity and Accuracy to Walking Speed Dynamics During a 6-Minute-Walk Test in Individuals With Mild Disability Due to Multiple Sclerosis and Healthy Controls

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Abstract

INTRODUCTION: People with multiple sclerosis (PwMS) show reduced speed and report negative associated experiences while walking. Imprecise multisensory integration may impair interoception during walking. We examined perceptive sensitivity and accuracy for gait speed changes in PwMS and healthy controls (HCs) during a 6-Minute Walk Test (6MWT).

METHODS: Thirty-six PwMS (age 46.8 ± 13.2 years; median Expanded Disability Status Scale score 2.5) and 36 HCs (age 41.6 ± 12.2 years) performed an instrumented 6MWT (APDM Wearable Technologies) and reported perceived gait speed changes by squeezing a time-synchronized handheld sensor. Detection sensitivity was quantified as the ratio between reports count and speed variability (CV). Objective gait speed fluctuations were identified using event detection algorithms to extract speed-change events (ie, event threshold: tangential acceleration > 0.0125 m/s2). Reports were considered accurate within 2 seconds of any event. Detection accuracy was analyzed using mixed-effects logistic regression, including event frequency as the covariate, and complemented by subjective confidence ratings (%).

RESULTS: During the 6MWT, walking speed was lower in PwMS than HCs (1.46 ± 0.23 m/s vs 1.80 ± 0.17 m/s; $P < .001$). PwMS had fewer events and reports, lowering detection sensitivity (1.03 ± 0.88 vs 2.71 ± 3.31; $P = .006$). Detection accuracy showed a significant group × event frequency interaction ($\beta = 0.474$; 95% CI, 0.089-0.859; $P = .016$): higher event frequency increased detection accuracy odds, with a stronger positive association in HCs. Above a reference event frequency of 4.2 events per minute, PwMS had reduced odds of accurate reporting compared with HCs. In contrast, HCs reported lower confidence ratings (59.5% ± 19.1%) than PwMS (71.5% ± 18.9%).

CONCLUSIONS: PwMS show reduced sensitivity and accuracy in detecting speed variations during prolonged walking compared with HCs, warranting tailored rehabilitation strategies.

114. Assessment of Perception Accuracy for Sit-To-Stand Exercise Using a Chair With Sensors in Individuals With Mild Disability due to Multiple Sclerosis and Healthy Controls

Gianluca Florio,[1,2] Lousin Moumdjian,[3] Felipe Balistieri Santinelli,[1,2] Deborah Severijns,[2] Daphne Kos,[2,4,5] Bruno Bonnechère,[1,2,6] Katleen Bogaerts,[1,2] Peter Feys[1,2]

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Abstract

INTRODUCTION: People with multiple sclerosis (PwMS) show impaired sit-to-stand (STS) performance; however, it is unknown whether their perception is affected by MS. Altered perception during STS may affect motor control and promote fatigue exacerbations. This study examines sit-to-stand perceptual accuracy and awareness in PwMS and healthy controls (HCs).

METHODS: A chair with sensors provided real-time seat-height tracking with precise control. Thirty-four PwMS with mild disability (age 45.9 ± 2.7; Expanded Disability Status Scale score 2.3 ± 1) and 34 HCs (age 40.9 ± 11.9) performed 36 STS trials (approximately every 10 seconds), with seat height changed in fixed steps every 1 to 3 trials (experimental seat height range was lower leg length ± 20%). Participants sat down and immediately stood up, reporting perceived seat height (from 0-100%). State fatigue was assessed pre-/post session; confidence (%) post session. Correspondence accuracy was calculated as within-subject correlations between imposed and perceived seat height. Group differences were tested with unpaired *t* tests, within-group associations with fatigue, and confidence with Spearman ρ.

RESULTS: No group differences in correspondence accuracy were observed (PwMS 0.88 ± 0.09 vs HCs 0.91 ± 0.10). In contrast, PwMS reported higher confidence than HCs (54.1 ± 19.8% vs 43.7 ± 18.8%; $P = .029$). Positive correlation between correspondence accuracy and confidence was found only in HCs ($\beta = 0.55$). PwMS reported higher state fatigue both pre-session (2.56 ± 1.99 vs 1.03 ± 1.04; $P = .0008$) and post session (4.24 ± 2.68 vs 1.98 ± 2.04; $P = .0002$) compared with HCs. However, correspondence accuracy was not associated with state fatigue in either group.

CONCLUSIONS: PwMS showed preserved and fatigue-independent correspondence accuracy, but lower awareness. This novel method can provide quantitative insights into the perception of self-mobility during STS, relevant to MS rehabilitation.

121. Robot-Assisted Gait Training vs Conventional Physiotherapy in Moderate-to-Severe Multiple Sclerosis: A Randomized Controlled Trial

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Abstract

BACKGROUND: Gait and balance impairments are highly prevalent in people with MS (PwMS) and contribute to functional decline, reduced participation, and poorer quality of life. Robot-assisted gait training enables intensive, task-specific rehabilitation, but comparative evidence with conventional physiotherapy (PT) in people with moderate-to-severe MS remains limited.

OBJECTIVE: To compare functional, emotional, quality-of-life, and safety outcomes of robot-assisted gait training using the Atalante exoskeleton (Exo) vs conventional physiotherapy (PT) in PwMS with moderate-to-severe disability.

METHODS: This prospective, randomized, rater-blinded clinical trial (NCT06615947) included 77 PwMS (Expanded Disability Status Scale score range, 6.0-7.0), assigned to Exo (n = 39) or PT (n = 38). Both groups completed 24 sessions over 8 weeks. The primary outcome was walking speed (10-Meter Walk Test). Secondary outcomes included walking endurance, balance, mobility, perceived walking limitations, fatigue, emotional status, and health-related quality of life. Safety, adherence, and usability were also monitored.

RESULTS: The PT group showed a significant improvement in walking speed, with a between-group difference favoring PT postintervention, although changes over time were not consistently different across outcomes. Both groups improved in balance, fatigue, and physical quality of life. Emotional outcomes improved modestly, with reductions in depressive symptoms observed only in the Exo group. No serious adverse events occurred, and both interventions were well tolerated, with high adherence (> 83%). The Exo group reported high satisfaction and usability despite a higher perceived technical risk.

CONCLUSIONS: Both interventions fielded comparable functional and psychosocial outcomes. Robot-assisted gait training was safe, feasible, and well accepted, supporting its role as a complementary option within comprehensive neurorehabilitation rather than as a superior alternative.

124. Effects of a Walking Exercise With or Without Closed-Loop Rhythmic Cueing on Spatiotemporal Gait Parameters at Self-Selected Pace in Individuals With Multiple Sclerosis and Walking Limitations

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Abstract

BACKGROUND: Gait disturbance is common in people with multiple sclerosis (PwMS) and is associated with walking and mobility limitations. Data from recent publications suggest that rhythmic auditory cueing (RC) results in short-term improvement in spatiotemporal (ST) gait parameters, but the combination of RC and exercise has not been thoroughly investigated. We have previously reported the feasibility, safety, and effects on walking capacity of using a closed-loop RC system combined with walking exercise (WE). The purpose of this analysis is to report efficacy on ST gait parameters.

METHODS: In this single, blind, parallel-group pilot randomized controlled trial, PwMS and a Timed 25-Foot Walk time of 8 to 30 seconds, were randomly assigned to 16 supervised WE sessions or 16 WE with closed loop RC (WE-RC) sessions. Outcomes were assessed at baseline, week 8 (end of intervention), and week 16. ST gait parameters at self-selected pace were measured on an instrumented walkway.

RESULTS: Seventeen participants (age, median [IQR] 57 [54, 61] years; 65% female; 70% progressive course, Expanded Disability Status Scale score, median [IQR] 4 [3.5, 6.5]) completed all assessment visits (WE-RC = 10, WE = 7). There was statistically significant improvement on step length, double support time, and velocity between baseline and 8 weeks for WE-RC, but not for WE. Although there were no statistically significant between-group differences on change in ST gait parameters, there was a trend favoring WE-RC for double support time (left $P = .05$; right $P = .07$) at week 8.

CONCLUSIONS: Our findings suggest that adding closed-loop RC to supervised WE may help improve ST gait parameters. These results need to be confirmed on a larger sample and under unsupervised conditions.

131. Home-Based Telerehabilitation as Continuity of Care After Intensive Rehabilitation in Multiple Sclerosis: Preliminary Results of a Pilot Randomized Controlled Trial

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Abstract

BACKGROUND: Balance impairments are common in people with multiple sclerosis (MS) and significantly affect mobility and fall risk. Intensive rehabilitation programs improve motor performance; however, these gains often decline over time without continued intervention. This pilot study aims to investigate the feasibility of a home-based telerehabilitation program through exergames to ensure continuity of care.

METHODS: Twenty-one individuals with MS were enrolled. Following a 3-week intensive inpatient rehabilitation, they were randomly assigned to intervention (n = 11) or control (n = 10). Participants in the intervention group performed a home-based telerehabilitation program 3 times per week for 12 weeks with tailored and remotely monitored exergames. The primary outcome was adherence; secondary outcomes included usability and exploratory clinical measures of mobility, balance, and quality of life, which were assessed at baseline (T0), post rehabilitation (T1), and at the 3-month follow-up (T2). The preliminary results of this study will be presented below, as 6 of the 21 participants are currently in the follow-up phase.

RESULTS: Mean age was 49.06 ± 10.54 years; mean Expanded Disability Status Scale score was 4.35 ± 1.28. Adherence to the telerehabilitation program was high (mean adherence: 93.98%); satisfaction scores indicated good acceptance of the platform (Telehealthcare Satisfaction Questionnaire mean score: 78 ± 11.98). Exploratory analyses suggested a trend toward better maintenance of functional mobility and balance outcomes in the intervention group compared with controls over the follow-up period. No adverse events were reported.

CONCLUSIONS: Home-based telerehabilitation through exergames may represent a feasible strategy to support long-term continuity of care after intensive rehabilitation, with good adherence and manageable technological and rehabilitative challenges.

133. Effects of a Multimodal Exercise Program on Disability, Physical Activity, Fatigue, and Quality of Life in People With Multiple Sclerosis: An Assessor-Blinded Randomized Controlled Study

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Abstract

BACKGROUND: Multiple sclerosis (MS) leads to progressive disability and is frequently accompanied by reduced physical activity, fatigue, and diminished quality of life. Multimodal exercise programs are increasingly used to address these impairments in people with MS.

OBJECTIVE: To investigate the effects of a multimodal exercise program on disability, physical activity, fatigue, and quality of life in people with MS.

METHODS: Twenty-four participants with MS (mean age 47.54 ± 10.44 years; Expanded Disability Status Scale score: 3.89 ± 0.79) were randomly assigned to a rehabilitation group or a control group. The rehabilitation group participated in a multimodal exercise program, whereas the control group received usual care. The program consisted of supervised sessions delivered 3 times per week for 12 weeks through a combination of face-to-face and online sessions via a telerehabilitation platform (TeleNoroRehab). Disability was assessed with the Multiple Sclerosis Functional Composite (MSFC), physical activity with accelerometry, fatigue with the Fatigue Severity Scale (FSS), and quality of life with the Multiple Sclerosis International Quality of Life Questionnaire (MusiQoL). Assessments were performed at baseline and postintervention by a blinded assessor.

Results: Following the 12-week intervention, the rehabilitation group demonstrated significant improvements in MSFC leg and arm *z* scores ($P = .018$; $P = .001$, respectively), MusiQoL ($P < .001$), and FSS $P = .003$). No significant changes were observed in the control group. Between-group analysis showed greater improvements in fatigue ($P = .010$) and quality of life ($P = .001$) in the rehabilitation group.

CONCLUSIONS: A multimodal exercise program may reduce fatigue and improve the quality of life in people with MS. These findings also support the potential of technology-enhanced telerehabilitation approaches to deliver effective rehabilitation.

ABSTRACT REVIEWERS

The Scientific Committee is honored and grateful for the support of the following abstract reviewers. The reviewers are listed alphabetically by last name.

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Marie Černá
Roshan das Nair
Vincent de Groot
Sofie Ferdinand
Martha Ghijselings
Andrea Giordano
Griet Gysemberg
Jan Havlík
Lars Hvid
Daphne Kos
Inger Løyning
Jan Mares
Lousin Moumdjian
Klara Novotná
Corinne Oosterlinck
Markéta Pavlíková
Ludovico Pedullà
Jessica Podda
Jana Poettgen
Anders Skjerbæk
Ivana Stetkarova
Cristina Ustrell Garrido
Libor Váša