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Personalized Exercise Prescription in Neuro Physiotherapy: Current Evidence and Future Perspectives

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Abstract

Exercise is central to neurological rehabilitation, yet standardized, one-size-fits-all prescriptions frequently fail to reflect the heterogeneity of impairment, disease trajectory, and personal context that characterize conditions such as stroke, Parkinson's disease (PD), multiple sclerosis (MS), spinal cord injury (SCI), and traumatic brain injury (TBI). This narrative review summarizes current evidence on individualized exercise prescription in neuro physiotherapy and identifies the factors that shape exercise selection, progression, and monitoring. A structured search of PubMed, Google Scholar, and Scopus-indexed literature was conducted, yielding evidence from randomized controlled trials, feasibility studies, systematic reviews, and clinical practice guidelines. Across conditions, individualization is most often anchored to physiological baselines - cardiopulmonary exercise testing, heart-rate reserve, one-repetition maximum, and rating of perceived exertion - with re-assessment at fixed intervals to adjust load. Disease-specific staging systems (Hoehn and Yahr stage, Expanded Disability Status Scale, American Spinal Injury Association Impairment Scale) and patient-level modifiers, including fatigue, cognition, comorbidity burden, self-efficacy, and motivation, further shape prescriptions. Wearable sensors, telerehabilitation platforms, and artificial-intelligence-driven decision-support tools increasingly enable continuous, adaptive personalization, though most such tools remain in feasibility or protocol stages and artificial-intelligence-generated programs still show limited precision and safety-biased conservatism compared with expert clinical judgment. Dose parameters - frequency, intensity, time, and progression - remain inconsistently reported across the literature, constraining reproducibility and evidence synthesis. This review recommends standardized dose reporting (aligned with the FITT-VP framework), wider adoption of physiological-threshold-anchored prescription, and cautious, clinician-supervised integration of digital and AI-based tools to advance truly individualized neuro-physiotherapy practice.

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1. Introduction

Exercise-based rehabilitation is one of the most consistently recommended interventions across neurological conditions, supported by decades of evidence linking structured physical activity to improved motor function, fitness, cognition, and quality of life in stroke, Parkinson's disease (PD), multiple sclerosis (MS), spinal cord injury (SCI), and traumatic brain injury (TBI)

[1-3]. Yet this population is fundamentally heterogeneous: two people with an identical diagnosis can differ enormously in impairment severity, disease stage, cardiovascular reserve, cognitive status, and fatigue burden. A prescription that is safe and effective for one may be under-dosed or contraindicated for another. This has driven a shift from standardized, protocol-driven programs toward personalized exercise prescription, in which type, intensity, frequency, and progression are deliberately tailored to a person's baseline function and response to training [4,5].

The rationale rests on two converging lines of evidence: dose-response is not linear, so both under- and over-dosing blunt benefit or provoke harm [6]; and inter-individual variability in training response is well documented even within a single condition, meaning fixed programs systematically under-serve some patients while over-taxing others [7]. Cardiovascular rehabilitation has already formalized individualized, threshold-anchored prescription as its clinical standard [8]; neuro physiotherapy is following a similar trajectory, but less consistently.

Personalization here operates on three levels: physiological anchoring (objective baseline testing to set individualized training zones) [9], patient-level modification (adjusting for disease stage, comorbidity, fatigue, and psychosocial context) [1], and technology-enabled adaptive personalization (wearables, telerehabilitation, and AI/ML tools that adjust load in near real time) [10,11]. These three levels, and their convergence on a single individualized prescription, are shown in Figure 1.

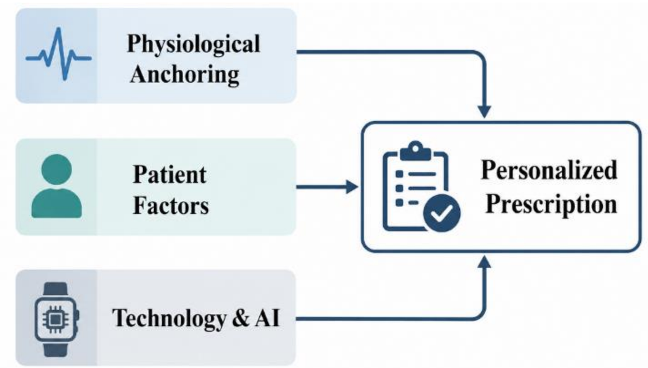

Fig 1: Conceptual framework of personalized exercise prescription in neuro physiotherapy, showing the three levels synthesized in this review - physiological anchoring, patient-level modification, and technology-enabled adaptation - converging on an individualized prescription.

This narrative review has two objectives: (1) to summarize current evidence on individualized exercise prescription across stroke, PD, MS, SCI, and TBI; and (2) to identify the factors that influence exercise selection, progression, and monitoring, highlighting gaps for future research.

2. Methods

This is a narrative review rather than a formal systematic review, given the breadth of synthesizing evidence across five neurological populations alongside qualitative prescription factors. The approach followed four stages [12]: (1) problem formulation around the two stated objectives; (2) literature search across PubMed/MEDLINE, Google Scholar, and Scopus-indexed sources, combining three concept blocks -exercise-prescription terms (exercise therapy, personalized/individualized exercise, precision rehabilitation), neurological-condition terms (stroke, Parkinson disease, multiple sclerosis, spinal cord injury, traumatic brain injury), and personalization/technology terms (precision medicine, algorithm, biomarker, wearable, dose-response) - combined with AND, supplemented by citation snowballing; (3) data evaluation for relevance to individualized or dose-specific prescription, including RCTs, feasibility studies, cohort studies, protocols, and systematic/network/umbrella reviews; and (4) data analysis, extracting population, FITT-VP intervention characteristics (Figure 2),personalization mechanism, monitoring/adherence method, outcomes, and reported gaps, synthesized thematically given the heterogeneity of designs and outcome measures across the literature [13].

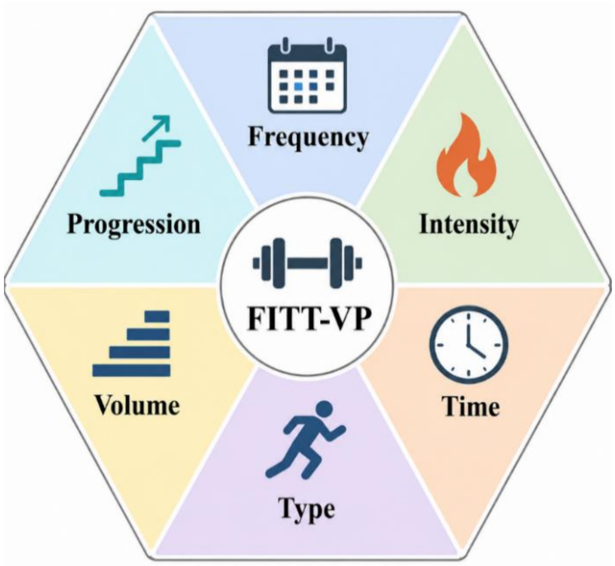

Fig 2: The FITT-VP framework (Frequency, Intensity, Time, Type, Volume, Progression) used as the standard data-extraction and reporting structure throughout this review.

3. Results: Current Evidence on Personalized Exercise Prescription

3.1. Overview of the evidence base

The literature spans stroke, PD, MS, SCI, and TBI, with a growing share of recent publications addressing AI-assisted and sensor-driven personalization specifically [10,14]. Study designs range from single-case reports to large network meta-analyses, and dose reporting is inconsistent throughout: an umbrella review of 144 stroke meta-analyses found intensity and progression parameters extractable in only a minority of primary studies [15], and a broader review of exercise-training principles found progression protocols reported completely in 0 of 25 systematic reviews assessed [16]. This reporting gap recurs throughout the sections below and is revisited in the Discussion.

3.2. Physiological-threshold-anchored prescription

The most consistent form of personalization is anchoring intensity to an individually determined physiological threshold rather than age-predicted values. In MS, trial protocols set resistance-training loads at 60-80% of one-repetition maximum and HIIT targets at 80-95% of measured peak heart rate, re-assessed at the trial midpoint and adjusted for disability level [9,17]. In PD, Griffith, McKee, et al. [18] argue explicitly for cardiopulmonary-exercise-test-based rather than estimated intensity prescription, and a companion trial found that autonomic-dysfunction status altered the functional response to a standardized endurance program, supporting further stratification [19]. Individualized load-setting extends to blood-flow-restriction protocols, which set occlusion pressure itself (typically 50-70% of arterial occlusion pressure) on the rationale that fixed cuff pressures produce inconsistent stimulus across differing limb morphology [20]. Threshold-anchored dose parameters for each condition are compiled in Table 1 (Section 3.3).

3.3. Condition-specific dose-response evidence

Dose-response relationships have been studied most extensively in stroke: Winstein et al. [6] argue that many negative upper-limb trials likely reflect insufficient rather than ineffective dosing, and a step-count/aerobic-minute roadmap has been proposed to standardize dose reporting going forward [21]. Network meta-analyses further show that different modalities suit different target outcomes - dual-task training for quality of life, resistance and robot-assisted training for sustained walking capacity - supporting a "match modality to outcome" model rather than one optimal prescription [22].

In PD, Bayesian network meta-analyses have begun quantifying optimal dose (in MET-minutes/week) as well as modality for balance and gait outcomes [23,24], and a prospective cohort study links standardized exercise volume to peripheral biomarkers and brain connectivity [25]. In MS, dose-response meta-analysis shows training effects scale with dose only up to a point [26], while a descriptive review of MS balance training found components, progression, and intensity so inconsistently reported that true dose-response synthesis was not possible [27] - a direct illustration of the reporting gap from Section 3.1. In SCI, upper-body ergometer rowing significantly improved peak aerobic power but not resting cardiometabolic markers over six months, suggesting the smaller active muscle mass in this population may need a different volume threshold than lower-body-referenced guidelines assume [28]. In TBI/concussion, the sub-symptom-threshold paradigm titrates intensity to the heart rate at which symptoms first emerge rather than to a fixed percentage of predicted maximum [29], and adherence to prescribed dose has itself been linked to faster concussion recovery [30]. Table 1 summarizes representative FITT-VP parameters across all five conditions.

Table 1: Summary FITT-VP Dose Parameters by Neurological Condition

Condition	Frequency	Intensity	Time / Duration	Progression	Key Sources
Stroke	2-5 sessions/week	Moderate-vigorous (40-80% HRR); HIIT protocols increasingly used	20-60 min/session; 3 weeks-6 months total	Stepwise increases in load, duration, or task complexity; step-count/aerobic-minute roadmaps	Winstein et al. [6]; Lang et al. [31]; Peters et al. [21]; Thompson et al. [32]
Parkinson's disease	2-7 sessions/week (endurance ~5×/week; strength/balance ~2×/week)	Moderate-vigorous (60-85% HR reserve/max); CPET-guided where available	30-90 min/session; up to 16 months in long programs	Individually tailored goal-setting; dose quantified in MET-min/week in recent network meta-analyses	Ramaswamy et al. [3]; Gilby et al. [33]; Fan et al. [23]; Xie et al. [24]; Griffith, McKee, et al. [18]
Multiple sclerosis	2-3 sessions/week	PRT: 60-80% 1RM; HIIT: 80-95% peak HR; continuous training: 60-80% HRmax	16-48 weeks program length; sessions ~20-60 min	Load/volume increased every 2 weeks (PRT); intensity re-set from repeat CPET at trial midpoint	Gravesteijn et al. [9]; Kupjetz et al. [17]; Riemenschneider et al. [34]; Hubbard et al. [35]
Spinal cord injury	Variable; 3-5 sessions/week in supervised protocols	Individualized to available active muscle mass; upper-body ergometry common	12–16-week interventions typical	Volume/resistance progressed against functional and metabolic markers	Hansen et al. [28]; Gorgey et al. [36]; Carey et al. [37]
Traumatic brain injury / concussion	5 sessions/week in aerobic-exercise trials	Sub-symptom-threshold: individualized to the heart rate at which symptoms first emerge	30 min/session; 6–12-week programs	Prescription updated every ~3 weeks from repeat symptom-limited exercise testing	Valaas et al. [29]; Mercier et al. [38]; Chizuk et al. [30]

Note: HRR = heart-rate reserve; HRmax = maximum heart rate; PRT = progressive resistance training; HIIT = high-intensity interval training; 1RM = one-repetition maximum; CPET = cardiopulmonary exercise testing. Ranges reflect the studies reviewed and are illustrative rather than prescriptive; individual dose should be set from patient-specific baseline testing.

3.4. Patient-specific factors influencing exercise selection, progression, and monitoring

Beyond physiological thresholds, several patient-level factors consistently shape prescription. Disease staging (EDSS in MS, Hoehn and Yahr in PD, AIS grade in SCI) functions as a de facto personalization variable, with the specific tailoring mechanisms for each disability band identified as a core extraction target in an updated MS guideline protocol [39]. Comorbidity: the PERFORM trial was designed explicitly around people with co-occurring long-term conditions, reflecting that single-diagnosis guidelines poorly serve multimorbid patients [40]. Fatigue is repeatedly identified as a primary dose-limiting factor, particularly in MS, where agility-based training has been compared directly against strength/endurance training for its differential effect on fatigability [41]. Cognition and psychosocial context: human-centered design work found that effective personalization required accounting for social support, cognitive status, depression, and fear of movement, not physiological variables alone [4]. Self-efficacy and motivation recur as both determinants of, and targets for, personalized prescription, with specific motivational drivers and barriers identified for individual counselling [42]. Metabolic status: outside neurology proper, individualized prescriptions incorporating fixed, adaptive, and response factors under a two-way patient-clinician communication model outperform standardized prescriptions for metabolic outcomes [43] - a model directly transferable to neuro-physiotherapy populations with high metabolic-syndrome prevalence. Table 2 summarizes these factors alongside their typical personalization response.

Table 2: Patient-Specific Factors Influencing Exercise Selection, Progression, and Monitoring

Factor	Clinical Relevance	Example Personalization Response	Representative Sources
Disability severity / disease staging	Determines baseline capacity and safety ceiling	Stratify prescription by EDSS (MS), Hoehn & Yahr stage (PD), or AIS grade (SCI)	Declerck et al. [39]; Jønsson et al. [20]; Babić et al. [14]
Comorbidity / multimorbidity	Single-diagnosis guidelines may not fit multimorbid patients	Multi-condition-aware protocols (e.g., PERFORM trial)	Simpson et al. [40]
Fatigue	Primary dose-limiting factor, especially in MS	Modality choice weighted toward lower fatigability (e.g., MAT vs. SET); fatigue as primary outcome	Wolf et al. [41]; Bailey et al. [44]
Cognition / psychosocial context	Shapes engagement with technology-based and cognitively demanding tasks	Adjust for MoCA score, depression, fear of movement, family/social support	Cucinella et al. [4]; De Meo et al. [45]
Self-efficacy and motivation	Predicts initiation and adherence, independent of physical capacity	Personalized, realizable goal-setting; motivational counselling on individual barriers	Cools et al. [42]; Gangwani et al. [46]; O'Neil-Pirozzi et al. [47]; Schootemeijer et al. [48]
Metabolic / systemic status	Influences intensity tolerance and cardiometabolic risk	Two-way communication model allowing patient-selected parameters within a clinician-set range	Kim, Choe, and Sung [43]

Note: EDSS = Expanded Disability Status Scale; AIS = American Spinal Injury Association Impairment Scale; MoCA = Montreal Cognitive Assessment; MAT = multimodal agility-based training; SET = strength and endurance training.

3.5. Technology-enabled personalization: wearables, telerehabilitation, and artificial intelligence

The most active area of recent growth is digital technology enabling continuous, adaptive personalization. Wearables close the feedback loop directly: a PD dynamic-cycling system adjusted resistance every three sessions from measured pedaling effort and cadence entropy [49]. Telerehabilitation achieves outcomes broadly comparable to face-to-face physiotherapy, though intensity monitoring remains its weakest methodological link [50]. Digital apps providing personalized exercise videos show a significant positive effect on physical function in MS and PD, though evidence certainty is rated low-to-very-low [51]. Artificial intelligence represents both the frontier of personalization and its greatest current limitation. Liew et al. [10] set out a roadmap for AI-driven precision neurorehabilitation, while Mo et al. [11] prospectively tested a machine-learning framework that individualized a twelve-week prescription from BMI and fitness data, reporting superior outcomes to static guidelines (a 23.5% reduction in overweight prevalence). Direct evaluations of generative-AI tools urge caution, however: a systematic review found large language models align with foundational FITT principles but consistently lack the specificity, progression logic, and real-time adaptability of expert prescribers, and in some cases show bias against older adults and people with disability [52] - a conclusion echoed by a focused evaluation of GPT-4-generated programs [53]. Given the narrower safety margins in neuro physiotherapy, AI is currently best treated as a supplement to, not a replacement for, clinician judgment. The assess-prescribe-monitor-adjust cycle common to these technologies is depicted in Figure 3.

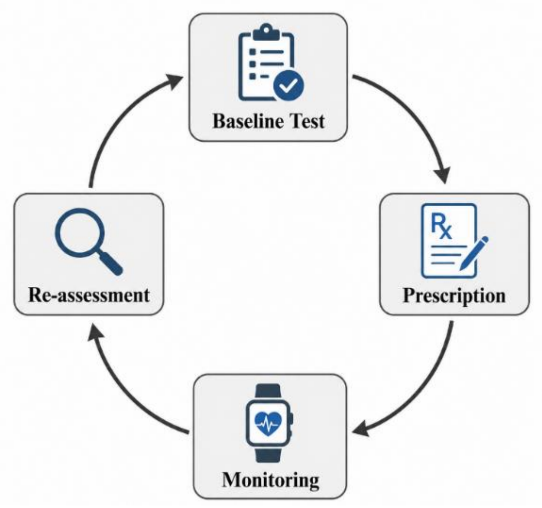

Fig 3: The technology-enabled personalization feedback loop: baseline assessment informs an initial prescription, which is continuously monitored (via wearables, apps, or AI-based tools), triggering re-assessment and an adjusted prescription.

Table 3: Technology-Enabled Personalization Tools and Current Evidence Maturity

Tool Category	Function in Personalization	Evidence Maturity	Representative Sources
Wearable sensors (HR monitors, smart insoles, accelerometers)	Continuous monitoring; closes the feedback loop for real-time load adjustment	Feasibility to early clinical use	Kim, Smith, et al. [49]; D'Arco et al. [54]; Klatt et al. [55]
Telerehabilitation platforms	Remote delivery of individualized exercise with variable supervision	Comparable outcomes to face-to-face care in systematic reviews; dose monitoring remains weak	Munoz-Tomas et al. [50]; Matamala-Gomez et al. [56]; Özden et al. [57]
Digital apps / SMS-based reminders	Support adherence and deliver personalized exercise video content	Positive effect on adherence and function; certainty of evidence low-moderate	Davergne et al. [51]; Lang et al. [58]
Machine-learning prescription frameworks	Data-driven individualization of dose from fitness/biomarker inputs	Promising in controlled cohorts; not yet validated at scale in neuro populations	Mo et al. [11]; Ye et al. [59]; Faria et al. [60]
Generative AI (e.g., large language models)	Free-form prescription generation from patient description	Immature: safety-biased, lacks progression precision, shows demographic bias	Puce et al. [52]; Dergaa et al. [53]
Biomarker-based subgroup clustering (e.g., HRV)	Stratifies patients into physiological response subgroups	Narrower but more clinically mature application of AI	Basri & Turki [61]; Ezzdine et al. [62]

Note: HRV = heart rate variability. "Evidence maturity" reflects the study designs and sample sizes reviewed in Section 3.5, not a formal GRADE assessment.

3.6. Adherence, monitoring, and real-world implementation

Personalization is only clinically meaningful if the prescribed dose is actually delivered - and adherence data here are sobering. In the BRiMS feasibility trial for secondary progressive MS, only 21% of participants logged at least 100 of the 120 weekly minutes advised, despite individualized, fortnightly-reviewed prescriptions [63]. Family and caregiver support repeatedly emerge as one of the strongest determinants of whether a prescribed home program is actually completed [64]. A scoping review of adherence in stroke survivors situates these findings within a broader pattern: barriers cluster around programme complexity, motivation, and the practicality of monitoring, suggesting adherence itself should be treated as a personalization target rather than a downstream outcome [65].

4. Discussion

4.1. Personalization is real but unevenly operationalized.

The field has moved beyond a single standardized prescription per diagnosis, with physiological-threshold anchoring now common in well-designed trials (Section 3.2). But rigor is far from universal: many feasibility studies describe individualization only qualitatively ("tailored to patient tolerance"), consistent with the broader finding that individualization as a training principle is reported completely in only a small minority of published exercise systematic reviews [16].

4.2. Dose reporting is the field's central methodological weakness.

The gap identified in Section 3.1 recurs independently across every condition - in MS balance training [27], the stroke umbrella review [15], and elsewhere. Without consistent FITT-VP reporting, neither clinicians nor future reviewers can reliably reproduce published "personalized" protocols.

4.3. Patient-specific factors matter as much as physiological thresholds, but are measured far less consistently.

Fatigue, cognition, comorbidity, and self-efficacy (Section 3.4, Table 2) are routinely cited as modifiers, yet no equivalent standardized instrument exists for weighting them the way heart rate or 1RM anchor physiological dosing. Emerging core-outcome-set initiatives [66] are an early step toward closing this gap.

4.4. Artificial intelligence is a genuinely emerging tool, not yet a mature one.

Studies showcasing AI's potential [11] sit alongside evaluations concluding that generative-AI tools still lack a clinician's specificity and real-time adaptability, and can carry demographic bias (Section 3.5). AI is best treated as a supplement to clinical judgment for now, particularly given the narrower safety margins in neuro physiotherapy (autonomic dysfunction in PD, symptom provocation in TBI, cardiovascular risk in SCI).

4.5. Adherence should be treated as a personalization target in its own right.

A precisely individualized prescription that is not delivered has no clinical effect; caregiver support and monitoring accuracy (Section 3.6) are at least as consequential to outcomes as dose precision itself.

4.6. Recommendations.

1. Routine FITT-VP-structured dose reporting in clinical and published records
2. wider adoption of physiological-threshold-anchored prescription with defined re-assessment intervals, where resources allow
3. systematic, tool-supported incorporation of patient-specific modifiers rather than informal clinical impression
4. cautious, clinician-supervised use of wearable and AI-based tools for monitoring and stratification - short of autonomous prescription - until current precision and bias concerns are resolved.

5. Conclusion

Personalized exercise prescription is increasingly central to effective neuro physiotherapy. Physiological-threshold-anchored dosing, staging-based tailoring, and technology-enabled monitoring are now well represented across stroke, PD, MS, SCI, and TBI research. At the same time, inconsistent dose reporting, the lack of standardized tools for weighting patient-specific modifiers, immature AI prescription technology, and modest real-world adherence together limit how far this evidence currently translates into reproducible clinical guidance. Advancing the field depends less on further isolated efficacy trials and more on standardizing how dose, personalization mechanism, and adherence are defined, measured, and reported.

Declarations

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References

1. Halabchi F, Alizadeh Z, Sahraian MA, Abolhasani M. Exercise prescription for patients with multiple sclerosis: potential benefits and practical recommendations. BMC Neurol. 2017;17(1):185. doi:10.1186/s12883-017-0960-9
2. Learmonth YC, Motl RW. Exercise training for multiple sclerosis: a narrative review of history, benefits, safety, guidelines, and promotion. Int J Environ Res Public Health. 2021;18(24):13245. doi:10.3390/ijerph182413245
3. Ramaswamy B, Jones J, Carroll C. Exercise for people with Parkinson's: a practical approach. Pract Neurol. 2018;18(5):399-406. doi:10.1136/practneurol-2018-001930
4. Cucinella SL, De Winter J, Grauwmeijer E, Evers M, Marchal-Crespo L. Towards personalized immersive virtual reality neurorehabilitation: a human-centered design. J Neuroeng Rehabil. 2025;22. doi:10.1186/s12984-024-01489-5
5. Wackerhage H, Schoenfeld B. Personalized, evidence-informed training plans and exercise prescriptions for performance, fitness and health. Sports Med. 2021;51:1805-13. doi:10.1007/s40279-021-01495-w
6. Winstein C, Kim B, Kim S, Martinez C, Schweighofer N. Dosage matters. Stroke. 2019;50(7):1831-7. doi:10.1161/STROKEAHA.118.023603
7. Xiao H, Ren J. Inter-individual heterogeneity in aerobic training adaptations: systematic review of the evidence base for personalized exercise prescription. Life (Basel). 2025;15. doi:10.3390/life15121932
8. Hansen D, Abreu A, Ambrosetti M, Cornelissen V, Gevaert A, Kemps H, et al. Exercise intensity assessment and prescription in cardiovascular rehabilitation and beyond: why and how: a position statement from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology. Eur J Prev Cardiol. 2021. doi:10.1093/eurjpc/zwab007
9. Gravesteijn AS, Beckerman H, de Jong BA, Hulst HE, de Groot V. Neuroprotective effects of exercise in people with progressive multiple sclerosis (Exercise PRO-MS): study protocol of a phase II trial. BMC Neurol. 2020;20(1):177. doi:10.1186/s12883-020-01765-6
10. Liew SL, Cotton RJ, Burdet E, Bermúdez I Badia S, Celnik P, Cole JH, et al. Collaborative AI for precision neurorehabilitation: a roadmap. J Neuroeng Rehabil. 2025;22(1):269. doi:10.1186/s12984-025-01810-w
11. Mo M, Li B, Yang Y, Kang P, Wang J, Luo W, et al. A machine learning framework for personalized exercise prescription based on BMI and physical fitness assessment. Sci Rep. 2026;16. doi:10.1038/s41598-026-42405-2
12. Alsultan M, Abdulah G, Alghamdi, Alhumaid AS. Investigate the principles and applications of task-specific training in neuro-physiotherapy rehabilitation. J Adv Scholarly Res Allied Educ. 2024. doi:10.29070/ms9xcn64
13. Bishnoi A, Lee R, Hu Y, Mahoney JR, Hernandez ME. Effect of treadmill training interventions on spatiotemporal gait parameters in older adults with neurological disorders: systematic review and meta-analysis of randomized controlled trials. Int J Environ Res Public Health. 2022;19(5):2824. doi:10.3390/ijerph19052824
14. Babić N, De Sousa BF, Levy J, Touzard F, Blancho S, Séguin P, et al. Feasibility of AI-driven multichannel FES-assisted gait and cycling training in chronic neurological disorders: a case series. J Neuroeng Rehabil. 2026;23(1):144. doi:10.1186/s12984-026-01953-4
15. Du M, Chen L, Li Y, Xia L, Liu Y, Guo M, et al. Effect of exercise-based interventions on stroke rehabilitation: an umbrella review of systematic reviews and meta-analyses. J Neuroeng Rehabil. 2025;22. doi:10.1186/s12984-025-01781-y
16. Morrison RT, et al. Attention to principles of training and exercise prescription in systematic reviews of exercise for functional performance in older adults: an umbrella review. Syst Rev. 2026. Advance online publication.
17. Kupjetz M, Joisten N, Rademacher A, Gonzenbach R, Bansi J, Zimmer P. Cycling in primary progressive multiple sclerosis (CYPRO): study protocol for a randomized controlled superiority trial evaluating the effects of high-intensity interval training in persons with primary progressive multiple sclerosis. BMC Neurol. 2023;23(1):162. doi:10.1186/s12883-023-03187-6
18. Griffith GJ, McKee KE, Lamotte G, Luthra NS, Corcos DM. Advice to people with Parkinson's in my clinic: get a cardiopulmonary exercise test. J Parkinsons Dis. 2025;15(3):654-63. doi:10.1177/1877718X251330814
19. Griffith GJ, Mehta N, Lamotte G, McKee KE, Suttman E, Haus JM, et al. Effects of 6 months of endurance exercise on motor function, exercise capacity, and autonomic function based on presence of autonomic dysfunction in individuals with early Parkinson's disease. J Parkinsons Dis. 2025;15(2):387-96. doi:10.1177/1877718X241308813
20. Jønsson A, Krogh S, Laursen H, Aagaard P, Kasch H, Nielsen JF. Safety and efficacy of blood flow restriction exercise in individuals with neurological disorders: a systematic review. Scand J Med Sci Sports. 2024;34. doi:10.1111/sms.14561
21. Peters S, Klassen T, Schneeberg A, Dukelow S, Bayley M, Hill M, et al. Step number and aerobic minute exercise prescription and progression in stroke: a roadmap. Neurorehabil Neural Repair. 2022;36(2):97-102. doi:10.1177/15459683211062894

22. Jiang L, Ding H, Ma Q, Gao S, Zhang X, Chun B. Comparing the effectiveness of different exercise interventions on quality of life in stroke patients: a randomized controlled network meta-analysis. BMC Neurol. 2025;25(1):24. doi:10.1186/s12883-025-04035-5
23. Fan X, Yuan Y, Bai Y, Cheng C, Wang J, Wang T, et al. Optimal dose and type of exercise improve the overall balance in adults with Parkinson's disease: a systematic review and Bayesian network meta-analysis. Neurol Sci. 2025;46(9):4169-80. doi:10.1007/s10072-025-08244-1
24. Xie S, Yuan Y, Wang J, Bai Y, Wang T, Qiu B, et al. Optimal dose and type of exercise improve walking velocity in adults with Parkinson's disease: a systematic review and Bayesian network meta-analysis. Sci Rep. 2025;15(1):2239. doi:10.1038/s41598-025-85456-7
25. Rotondo R, Padua E, Annino G, Guescini M, Donati-Zeppa S, Goffredo M, et al. Dose-response effects of physical exercise standardized volume on peripheral biomarkers, clinical response, and brain connectivity in Parkinson's disease: a prospective, observational, cohort study. Front Neurol. 2024;15. doi:10.3389/fneur.2024.1412311
26. Corrini C, Gervasoni E, Perini G, Cosentino C, Putzolu M, Montesano A, et al. Mobility and balance rehabilitation in multiple sclerosis: a systematic review and dose-response meta-analysis. Mult Scler Relat Disord. 2023;69:104424. doi:10.1016/j.msard.2022.104424
27. Brincks J, Dalgas U, Franzén E, Callesen J, Wallin A, Johansson S. Unwrapping the "black box" of balance training in people with multiple sclerosis: a descriptive systematic review of intervention components, progression, and intensity. Mult Scler Relat Disord. 2023;69:104412. doi:10.1016/j.msard.2022.104412
28. Hansen RK, Laessoe U, Samani A, Mellergaard M, Rasmussen RW, Handberg A, et al. Impact of upper-body ergometer rowing exercise on aerobic fitness and cardiometabolic disease risk in individuals with spinal cord injury: a 6-month follow-up study. J Spinal Cord Med. 2024;47(6):996-1006. doi:10.1080/10790268.2023.2233820
29. Valaas LJV, Soberg HL, Rasmussen MS, Steenstrup SE, Andelic N, Kleffelgård I. Sub-symptom threshold aerobic exercise for patients with persisting post-concussion symptoms and exercise intolerance after mild traumatic brain injury: a study protocol with a nested feasibility study for a randomized controlled trial. BMC Neurol. 2023;23(1):179. doi:10.1186/s12883-023-03221-7
30. Chizuk H, Willer B, Cunningham A, Bezherano I, Storey E, Master C, et al. Adolescents with sport-related concussion who adhere to aerobic exercise prescriptions recover faster. Med Sci Sports Exerc. 2022;54:1410-6. doi:10.1249/mss.0000000000002952
31. Lang CE, Strube MJ, Bland MD, Waddell KJ, Cherry-Allen KM, Nudo RJ, et al. Dose response of task-specific upper limb training in people at least 6 months poststroke: a phase II, single-blind, randomized, controlled trial. Ann Neurol. 2016;80(3):342-54. doi:10.1002/ana.24734
32. Thompson ED, Pohlig RT, McCartney KM, Hornby TG, Kasner SE, Raser-Schramm J, et al. Increasing activity after stroke: a randomized controlled trial of high-intensity walking and step activity intervention. Stroke. 2024;55(1):5-13. doi:10.1161/STROKEAHA.123.044596
33. Gilby J, Kent B, Lozano RK, Marsden J. Interventions for promoting physical activity in people with newly diagnosed Parkinson's disease: scoping review. Syst Rev. 2025;14(1):164. doi:10.1186/s13643-025-02892-2
34. Riemenschneider M, Hvid LG, Ringgaard S, Nygaard MKE, Eskildsen SF, Petersen T, et al. Study protocol: randomised controlled trial evaluating exercise therapy as a supplemental treatment strategy in early multiple sclerosis: the Early Multiple Sclerosis Exercise Study (EMSES). BMJ Open. 2021;11(1):e043699. doi:10.1136/bmjopen-2020-043699
35. Hubbard EA, Motl RW, Elmer DJ. Feasibility and initial efficacy of a high-intensity interval training program using adaptive equipment in persons with multiple sclerosis who have walking disability: study protocol for a single-group, feasibility trial. Trials. 2020;21(1):972. doi:10.1186/s13063-020-04887-x
36. Gorgey AS, Khalil RE, Gill R, O'Brien LC, Lavis T, Castillo T, et al. Effects of testosterone and evoked resistance exercise after spinal cord injury (TEREX-SCI): study protocol for a randomised controlled trial. BMJ Open. 2017;7(4):e014125. doi:10.1136/bmjopen-2016-014125
37. Carey RL, Le H, Coffman DL, Nahum-Shani I, Thirumalai M, Hagen C, et al. mHealth-based just-in-time adaptive intervention to improve the physical activity levels of individuals with spinal cord injury: protocol for a randomized controlled trial. JMIR Res Protoc. 2024;13:e57699. doi:10.2196/57699
38. Mercier LJ, Fung TS, Harris AD, Dukelow SP, Debert CT. Improving symptom burden in adults with persistent post-concussive symptoms: a randomized aerobic exercise trial protocol. BMC Neurol. 2020;20(1):46. doi:10.1186/s12883-020-1622-x
39. Declerck L, Ginis KM, Cheung AL, Jeng B, Zheng P, Huynh TLT, et al. Effects of exercise training among adults with multiple sclerosis: protocol for a systematic review that informs an updated prescriptive guideline. Syst Rev. 2026;15(1):83. doi:10.1186/s13643-026-03095-z
40. Simpson S, Evans R, Gilbert H, Branson A, Barber S, McIntosh E, et al. Personalised Exercise-Rehabilitation FOR people with Multiple long-term conditions (PERFORM): protocol for a randomised feasibility trial. BMJ Open. 2024;14. doi:10.1136/bmjopen-2023-083255
41. Wolf F, Nielsen J, Saliger J, Hennecken E, Kröber P, Eschweiler M, et al. Multimodal agility-based exercise training (MAT) versus strength and endurance training (SET) to improve multiple sclerosis-related fatigue and fatigability during inpatient rehabilitation: a randomized controlled pilot and feasibility study (ReFEx). BMC Neurol. 2023;23(1):388. doi:10.1186/s12883-023-03436-8

42. Cools C, Kotz S, Bloem B, Duits A, de Vries N. Motivation matters: elucidating factors driving exercise in people with Parkinson disease. Phys Ther. 2025;105. doi:10.1093/ptj/pzaf048
43. Kim KB, Choe H, Sung H. Effects of individualized exercise on risk factors of metabolic syndrome: a scoping review. J Obes Metab Syndr. 2024;33:20-6. doi:10.7570/jomes23020
44. Bailey DP, Norris E, LeWarne MD, Cerexhe L, Anokye N, Banstola A, et al. Clinical and cost-effectiveness of the iStep-MS physical activity and sedentary behaviour intervention for managing fatigue in people with multiple sclerosis: protocol for a multicentre randomised controlled trial. BMJ Open. 2026;16(7):e121358. doi:10.1136/bmjopen-2026-121358
45. De Meo E, Portaccio E, Bonacchi R, Giovannoli J, Niccolai C, Amato MP. An update on the treatment and management of cognitive dysfunction in patients with multiple sclerosis. Expert Rev Neurother. 2025;25(2):227-43. doi:10.1080/14737175.2025.2450788
46. Gangwani R, Cain A, Collins A, Cassidy J. Leveraging factors of self-efficacy and motivation to optimize stroke recovery. Front Neurol. 2022;13. doi:10.3389/fneur.2022.823202
47. O'Neil-Pirozzi T, Cattaneo G, Solana-Sánchez J, Gomes-Osman J, Pascual-Leone Á. The importance of motivation to older adult physical and cognitive exercise program development, initiation, and adherence. Front Aging. 2022;3. doi:10.3389/fragi.2022.773944
48. Schootemeijer S, van der Kolk NM, Ellis T, Mirelman A, Nieuwboer A, Nieuwhof F, et al. Barriers and motivators to engage in exercise for persons with Parkinson's disease. J Parkinsons Dis. 2020;10(4):1293-9. doi:10.3233/JPD-202247
49. Kim Y, Smith BE, Shigo L, Shaikh AG, Loparo KA, Ridgel AL. Assessing changes in motor function and mobility in individuals with Parkinson's disease after 12 sessions of patient-specific adaptive dynamic cycling. Sensors (Basel). 2024;24(22):7364. doi:10.3390/s24227364
50. Munoz-Tomas M, Burillo-Lafuente M, Vicente-Parra A, Sanz-Rubio MC, Suárez-Serrano C, Marcén-Román Y, et al. Telerehabilitation as a therapeutic exercise tool versus face-to-face physiotherapy: a systematic review. Int J Environ Res Public Health. 2023;20. doi:10.3390/ijerph20054358
51. Davergne T, Meidinger P, Dechartres A, Gossec L. The effectiveness of digital apps providing personalized exercise videos: systematic review with meta-analysis. J Med Internet Res. 2022;25. doi:10.2196/45207
52. Puce L, Bragazzi N, Currà A, Trompetto C. Harnessing generative artificial intelligence for exercise and training prescription: applications and implications in sports and physical activity—a systematic literature review. Appl Sci (Basel). 2025. Advance online publication. doi:10.3390/app15073497
53. Dergaa I, Saad B, Omri AE, Glenn J, Clark C, Washif J, et al. Using artificial intelligence for exercise prescription in personalised health promotion: a critical evaluation of OpenAI's GPT-4 model. Biol Sport. 2023;41:221-41. doi:10.5114/biolsport.2024.133661
54. D'Arco L, Wang H, Zheng H. Integration of smart insoles for gait assessment in exoskeleton assisted rehabilitation. Sci Rep. 2025;15(1):28350. doi:10.1038/s41598-025-10032-y
55. Klatt B, Bao T, Sienko K, Hoppes C, Sparto P, Whitney S. Rating scales to inform balance exercise difficulty during rehabilitation for individuals with neurological disorders. Front Rehabil Sci. 2026;7. doi:10.3389/fresc.2026.1703537
56. Matamala-Gomez M, Maisto M, Montana J, Mavrodiev PA, Baglio F, Rossetto F, et al. The role of engagement in teleneurorehabilitation: a systematic review. Front Neurol. 2020;11. doi:10.3389/fneur.2020.00354
57. Özden F, Özkeskin M, Ak SM. Physical exercise intervention via telerehabilitation in patients with neurological disorders: a narrative literature review. Egypt J Neurol Psychiatr Neurosurg. 2022;58:1-9. doi:10.1186/s41983-022-00461-1
58. Lang S, McLelland C, MacDonald D, Hamilton D. Do digital interventions increase adherence to home exercise rehabilitation? A systematic review of randomised controlled trials. Arch Physiother. 2022;12. doi:10.1186/s40945-022-00148-z
59. Ye D, Luo H, Winstein C, Schweighofer N. Towards AI-based precision rehabilitation via contextual model-based reinforcement learning. J Neuroeng Rehabil. 2025;22(1):263. doi:10.1186/s12984-025-01771-0
60. Faria A, Almeida Y, Branco D, Câmara J, Cameirão M, Ferreira L, et al. NeuroAIreh@b: an artificial intelligence-based methodology for personalized and adaptive neurorehabilitation. Front Neurol. 2024;14. doi:10.3389/fneur.2023.1258323
61. Basri AM, Turki AF. Evaluating heart rate variability as a biomarker for autonomic function in Parkinson's disease rehabilitation: a clustering-based analysis of exercise-induced changes. Medicina (Kaunas). 2025;61(3):527. doi:10.3390/medicina61030527
62. Ezzdine LB, Dhahbi W, Dergaa I, Ceylan H, Guelmami N, Saad B, et al. Physical activity and neuroplasticity in neurodegenerative disorders: a comprehensive review of exercise interventions, cognitive training, and AI applications. Front Neurosci. 2025;19. doi:10.3389/fnins.2025.1502417
63. Gunn H, Andrade J, Paul L, Miller L, Creanor S, Stevens K, et al. A self-management programme to reduce falls and improve safe mobility in people with secondary progressive MS: the BRiMS feasibility RCT. Health Technol Assess. 2019;23(27):1-166. doi:10.3310/hta23270
64. Zhang Y, Qiu X, Jin Q, Ji C, Yuan P, Cui M, et al. Influencing factors of home exercise adherence in elderly patients with stroke: a multiperspective qualitative study. Front Psychiatry. 2023;14. doi:10.3389/fpsyt.2023.1157106
65. Gwynne-Mayer N, Drummond A, Hancox J, Alrubaia W, Taylor I. Adherence to exercise rehabilitation programmes in stroke survivors: a scoping review. BMJ Open Sport Exerc Med. 2025;11. doi:10.1136/bmjsem-2024-002102

66. Ramdharry G, Buscemi V, Boaz A, Dawes H, Jaki T, Jones F, et al. Proposing a core outcome set for physical activity and exercise interventions in people with rare neurological conditions. Front Rehabil Sci. 2021;2. doi:10.3389/fresc.2021.705474

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