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USO E CARACTERIZAÇÃO DE ESTRATÉGIAS DE APRENDIZAGEM MOTORA E CONDIÇÕES DE PRÁTICA PARA A MELHORA DA MARCHA NA DOENÇA DE PARKINSON: UMA REVISÃO SISTEMÁTICA

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Uso e caracterização de estratégias de aprendizagem motora e condições de prática para a melhora da marcha na doença de Parkinson: uma revisão sistemática

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RESUMO

A doença de Parkinson (DP) é uma doença neurodegenerativa progressiva e a segunda mais comum no mundo. Compromete funções motoras e não motoras, sendo as alterações da marcha uma das principais causas de incapacidade funcional. Esses déficits estão associados a prejuízos no controle motor e na capacidade de adquirir, reter e transferir novas habilidades, destacando a importância de compreender os processos de aprendizagem motora na reabilitação. No entanto, embora a aprendizagem motora seja um componente inerente aos processos de reabilitação motora, ainda não está claro quais estratégias são mais adequadas para indivíduos com diferentes perfis clínicos e cognitivos da DP, nem como essas estratégias são selecionadas e implementadas na reabilitação da marcha. Esta dissertação teve como objetivo identificar, descrever e classificar as estratégias de aprendizagem motora e as condições de prática utilizadas em intervenções voltadas à melhora da marcha em pessoas com DP. Foi realizada uma revisão sistemática de ensaios clínicos, com busca realizada em oito bases de dados e análise descritiva da frequência e da forma de aplicação dessas estratégias. Foram incluídos 126 estudos, cujas intervenções foram classificadas segundo uma proposta elaborada e refinada pelo grupo de pesquisa, fundamentada em referenciais teóricos da aprendizagem motora. Estratégias de foco externo e pistas sensoriais foram as mais frequentemente identificadas, seguidas pelo feedback aumentado. As condições de prática mais frequentemente identificadas foram a especificidade da prática, a variabilidade da prática e a simplificação de tarefas. A maioria dos estudos combinou múltiplas estratégias de aprendizagem motora em um mesmo protocolo. Entretanto, observou-se considerável heterogeneidade na forma como os princípios de aprendizagem motora foram descritos, implementados e justificados. Além disso, características clínicas e cognitivas dos participantes raramente foram consideradas na seleção das estratégias utilizadas. Esses achados contribuem para uma compreensão mais sistemática da utilização dos princípios da aprendizagem motora na reabilitação da marcha em pessoas com DP e reforçam a necessidade de abordagens mais individualizadas, que considerem as características motoras e cognitivas dos pacientes na seleção das estratégias de intervenção.

Palavras-chave: Doença de Parkinson; Aprendizagem; Marcha; Reabilitação.

Objetivos de Desenvolvimento Sustentável (ODS): ODS 3 – Saúde e Bem-Estar

ABSTRACT

Parkinson’s disease (PD) is the second most common neurodegenerative disorder worldwide. It affects both motor and non-motor functions, and gait impairment is a primary cause of functional disability. Gait deficits are associated with impaired motor control and reduced ability to acquire, retain, and transfer motor skills, highlighting the importance of understanding motor learning processes in rehabilitation. However, although motor learning is an inherent component of motor rehabilitation, it remains unclear which motor learning strategies are most appropriate for individuals with different clinical and cognitive profiles of PD, or how these strategies are selected and implemented in gait rehabilitation. This study aimed to identify, describe, and classify motor learning strategies and practice conditions used in interventions targeting gait improvement in people with PD (PwPD). A systematic review of clinical trials was conducted. Eight databases were searched, and a descriptive analysis examined the frequency and implementation of these strategies. A total of 126 studies were included, and the interventions were classified according to a classification proposal developed and refined by the research group, based on theoretical principles of motor learning. External focus and sensory cueing were the most frequently identified strategies, followed by augmented feedback. The most frequently identified practice conditions were practice specificity, practice variability, and task simplification. Most studies combined multiple motor learning strategies within the same intervention protocol. However, substantial heterogeneity was observed in how motor learning principles were described, implemented, and justified. Furthermore, participants' clinical and cognitive characteristics were rarely considered when selecting rehabilitation strategies. These findings contribute to a more systematic understanding of the application of motor learning principles in gait rehabilitation for PwPD and reinforce the need for more individualized approaches that consider patients' motor and cognitive characteristics when selecting rehabilitation strategies.

Keywords: Parkinson’s disease; Learning; Gait; Rehabilitation.

Sustainable Development Goals (SDGs): SDG 3 – Good Health and Well-Being.

LISTA DE ABREVIATURAS E SIGLAS

Abreviaturas e siglas em português

DP	Doença de Parkinson

Abreviaturas e siglas em inglês

PD	Parkinson’s disease
PwPD	People with Parkinson’s disease
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
RoB 2	Cochrane Risk of Bias 2
ROBINS-I	Risk of Bias in Non-randomized Studies of Interventions

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1. INTRODUÇÃO

A doença de Parkinson (DP) é a mais comum das doenças neurodegenerativas do movimento em todo o mundo, afetando cerca de 1% das pessoas com mais de 60 anos (BALESTRINO; SCHAPIRA, 2020). O seu impacto tem crescido de forma gradual nas últimas décadas, principalmente em decorrência do envelhecimento da população (COLEMAN; MARTIN, 2022). No Brasil, estimativas sugerem que o número de indivíduos com DP poderá crescer de cerca de 536 mil em 2024 para mais de 1,25 milhão até 2060, evidenciando a relevância clínica e epidemiológica em ascensão da doença (SCHLICKMANN et al., 2025). Embora classicamente associada à degeneração de neurônios dopaminérgicos da substância negra, a DP é atualmente compreendida como uma condição complexa que envolve alterações em múltiplas redes neurais relacionadas ao controle motor, cognição, atenção e integração sensório-motora (SIMON et al., 2020; MEDER et al., 2019; REN et al., 2026).

As alterações da marcha são um dos principais fatores associados à perda da independência funcional em indivíduos com DP, comprometendo significativamente a mobilidade, o desempenho nas atividades de vida diária e a participação social (TAN et al., 2012). Dentre as alterações da marcha destacam-se a redução do comprimento do passo, a diminuição da velocidade e os episódios de congelamento, que contribuem para a perda da autonomia e para a redução da qualidade de vida (MIRELMAN et al., 2019). Além das alterações motoras, a DP também está associada a comprometimentos cognitivos e atencionais que aumentam a demanda de recursos cognitivos durante a realização de tarefas motoras (AARSLAND et al., 2021). Nesse contexto, há indícios de que a doença também afeta processos relacionados à aprendizagem motora, comprometendo a aquisição, retenção e automatização de habilidades motoras (NIEUWBOER et al., 2009; OLSON et al., 2019). Como consequência, a formação e o aperfeiçoamento de novos padrões de movimento podem tornar-se mais desafiadores para pessoas com DP.

A aquisição e o refinamento de habilidades motoras dependem de processos de aprendizagem motora que envolvem mudanças relativamente permanentes na capacidade de executar habilidades motoras como resultado da prática e da

experiência (MARINELLI et al., 2017; KLEYNEN et al., 2020). Esse processo pode ocorrer por meio de mecanismos explícitos ou implícitos de aprendizagem. A aprendizagem explícita caracteriza-se pela aquisição consciente de conhecimentos sobre uma determinada tarefa, envolvendo atenção, raciocínio e funções executivas. Em contraste, a aprendizagem implícita ocorre com menor envolvimento consciente, sendo baseada na experiência prática e no desenvolvimento gradual de habilidades mais automatizadas. Em indivíduos com DP, alterações nos circuitos córtico-estriatais e déficits cognitivos podem interferir nesses processos, especialmente naqueles relacionados à automaticidade do movimento e à adaptação motora durante a prática (OLSON et al., 2019). Como consequência, padrões de marcha previamente automatizados podem tornar-se menos eficientes, exigindo que o indivíduo desenvolva novas estratégias para controlar, adaptar e manter a locomoção diante das limitações impostas pela doença. Nesse contexto, a aprendizagem motora assume papel central na reabilitação da marcha, uma vez que a recuperação funcional depende da capacidade de modificar e aperfeiçoar o comportamento motor por meio da prática.

Na prática clínica, os princípios da aprendizagem motora são aplicados por meio de diferentes estratégias e condições de prática. A forma como as informações são fornecidas ao indivíduo, o direcionamento da atenção durante a execução das tarefas e a organização da prática podem influenciar tanto o desempenho quanto a aprendizagem motora (MAGILL; ANDERSON, 2021). Na reabilitação da marcha de pessoas com DP, são utilizadas diferentes estratégias, incluindo feedback aumentado, foco externo e pistas sensoriais, observação da ação, imagética motora e foco interno. Além disso, condições de prática, como variabilidade, especificidade, simplificação e segmentação da tarefa, podem influenciar a aquisição, retenção e transferência de habilidades motoras (MAGILL; ANDERSON, 2021; KLEYNEN et al., 2020). A seleção dessas estratégias deve considerar características do indivíduo, da tarefa e do estágio de aprendizagem, uma vez que diferentes abordagens podem demandar distintos níveis de processamento cognitivo e envolvimento consciente durante a prática (KLEYNEN et al., 2020).

Apesar dos princípios da aprendizagem motora estarem cada vez mais presentes na reabilitação da marcha em indivíduos com DP, ainda há pouco conhecimento sobre como essas estratégias e condições de prática são aplicadas nos protocolos de intervenção. A ausência de descrições detalhadas, critérios claros

de classificação e justificativas consistentes para a seleção das estratégias torna a compreensão dos estudos e a tradução desse conhecimento para a prática clínica bastante desafiadoras. Além disso, frequentemente não fica claro se a escolha dessas estratégias decorre de um planejamento fundamentado nos princípios da aprendizagem motora e nas características dos indivíduos ou se emerge apenas da estrutura geral do treinamento proposto. Portanto, torna-se necessária uma análise sistemática capaz de identificar, descrever e classificar as estratégias de aprendizagem motora e as condições de prática empregadas em intervenções voltadas à melhora da marcha em indivíduos com DP.

2. CONTEXTUALIZAÇÃO

2.1. Epidemiologia, etiologia e fisiopatologia da doença de Parkinson

A DP é o distúrbio do movimento mais comum e a segunda doença neurodegenerativa mais prevalente do sistema nervoso central, atrás apenas da doença de Alzheimer (CACABELOS, 2017). O aumento da população idosa tem elevado sua prevalência nas últimas décadas, resultando em um impacto cada vez maior sobre os sistemas de saúde em todo o mundo (COLEMAN; MARTIN, 2022; LI et al., 2025). No Brasil, estimativas apontam que o número de pessoas com a doença aumentará significativamente nas próximas décadas, o que ressalta a urgência de desenvolver e implementar estratégias de tratamento e reabilitação eficazes (SCHLICKMANN et al., 2025).

A DP é fruto de uma etiologia multifatorial, sendo, na maioria dos casos, considerada idiopática, mas com evidências de interação entre fatores genéticos e ambientais (BEN-SHLOMO et al., 2024). A idade avançada é o traço mais característico de risco, uma vez que está ligada às alterações funcionais progressivas das células nervosas (REEVE et al., 2014). Em termos celulares, o acúmulo anormal de alfa-sinucleína é o mais evidente. O seu acúmulo, em contextos patológicos, compromete a função sináptica, altera a transmissão dopaminérgica e dá início a processos como estresse oxidativo, disfunção mitocondrial e neuroinflamação, contribuindo para a progressão da neurodegeneração (CALABRESI et al., 2023).

Fisiopatologicamente, a DP se caracteriza, em sua maioria, pela degeneração progressiva dos neurônios dopaminérgicos localizados na substância negra *pars compacta*, resultando em diminuição da dopamina no estriado (ZHOU et al., 2023). Essa perda dopaminérgica provoca alterações no funcionamento dos circuitos córtico-estriatais e dos núcleos da base, comprometendo a regulação do movimento e contribuindo diretamente para o surgimento dos principais sintomas motores da doença (BENAZZOUZ et al., 2014).

Evidências neuropatológicas e de neuroimagem demonstram que outros sistemas neurotransmissores, incluindo vias colinérgicas, serotoninérgicas e noradrenérgicas, também são afetados ao longo da progressão da doença (BUDDHALA et al., 2015; BOHNEN et al., 2022). Esses sistemas participam de funções relacionadas à cognição, atenção, humor, processamento sensorial e controle postural (BOHNEN et al., 2022). Portanto, a DP é atualmente compreendida como uma condição neurodegenerativa complexa que afeta múltiplas redes neurais envolvidas no controle motor, na cognição e na integração sensório-motora, contribuindo para a ampla heterogeneidade clínica observada entre os indivíduos acometidos pela doença (REN et al., 2026; MEDER et al., 2019).

2.2. Manifestações clínicas e alterações da marcha na doença de Parkinson

A DP é caracterizada por um conjunto de sinais e sintomas, tanto motores quanto não motores, que se intensificam de maneira progressiva. Os sintomas motores mais característicos da doença incluem bradicinesia, rigidez, tremor em repouso e instabilidade postural (JANKOVIC, 2008). Essas mudanças resultam em perdas na organização e no controle do movimento, o que diminui a amplitude do movimento, piora a regulação temporal e aumenta a variabilidade motora (MIRELMAN et al., 2019; OLSON et al., 2019).

Indivíduos com DP costumam apresentar um passo mais curto, uma marcha mais lenta, maior variabilidade no espaço e no tempo, além de episódios de congelamento da marcha, especialmente quando precisam se adaptar mais ao ambiente ou quando a atenção está mais exigida (MIRELMAN et al., 2019). Considerando que a marcha é fundamental para a execução das tarefas diárias, tais mudanças impactam diretamente na mobilidade, na independência funcional e na

participação social das pessoas (TAN et al., 2012). A relevância da mobilidade ultrapassa o desempenho motor isolado. A Organização Mundial da Saúde reconhece a capacidade locomotora como um componente da capacidade intrínseca, fundamental para a manutenção da mobilidade e da independência, e inclui a velocidade da marcha entre as medidas utilizadas para sua avaliação (WORLD HEALTH ORGANIZATION, 2021). Além disso, a mobilidade integra a capacidade funcional necessária para que os indivíduos realizem atividades que consideram importantes e mantenham sua participação na sociedade (WORLD HEALTH ORGANIZATION, 2021).

A DP também se associa a sintomas não motores, incluindo déficits cognitivos, distúrbios do sono, disfunções autonômicas e sintomas neuropsiquiátricos (SVEINBJÖRNSDOTTIR, 2016). Esses sintomas podem influenciar tanto o desempenho motor durante a execução da tarefa quanto o aprendizado e a adaptação de novas habilidades motoras.

2.3 Aprendizagem motora e reabilitação da marcha na doença de Parkinson

A aprendizagem motora é um conjunto de processos relacionados à prática e à experiência que levam a alterações de longa duração na capacidade de executar habilidades motoras (MAGILL; ANDERSON, 2021). Esse processo envolve a aquisição, consolidação, retenção e transferência de habilidades motoras, permitindo que os indivíduos ajustem seus movimentos diante de diferentes demandas e contextos (MARINELLI et al., 2017; KLEYNEN et al., 2020). Nesse contexto, as estratégias de aprendizagem motora correspondem às diferentes formas de organizar a informação, direcionar a atenção e estruturar a prática com o objetivo de favorecer a aquisição, a retenção e a transferência de habilidades motoras. Ao contrário das mudanças temporárias que podem surgir após uma única sessão de treino, a aprendizagem motora implica em modificações duradouras no desempenho que são mantidas ao longo do tempo e transferidas para diferentes contextos funcionais (MAGILL; ANDERSON, 2021).

A aprendizagem motora abrange tanto mecanismos explícitos quanto implícitos. A aprendizagem explícita é a obtenção consciente de informações sobre a tarefa, o que envolve atenção, raciocínio e funções executivas. Por outro lado, a

aprendizagem implícita se dá com menos consciência, sendo moldada ao longo do tempo pela prática e pela vivência. Apesar de ambos os mecanismos ajudarem na aquisição de habilidades motoras, eles variam em relação às exigências cognitivas e aos processos neurais que acionam (MARINELLI et al., 2017; KLEYNEN et al., 2020).

Do ponto de vista neurobiológico, a aquisição e o aperfeiçoamento de habilidades motoras dependem da interação entre múltiplos sistemas neurais relacionados ao planejamento, execução, adaptação e automatização do movimento (MARINELLI et al., 2017; KLEYNEN et al., 2020). Além dos circuitos sensório-motores, esse processo requer funções cognitivas como atenção, memória de trabalho e controle executivo, especialmente durante a aquisição e adaptação de novas habilidades motoras (MARINELLI et al., 2017). Na DP, modificações nos circuitos córtico-estriatais e nas funções cognitivas frequentemente comprometidas pela doença podem interferir em mecanismos que sustentam a automaticidade do movimento e impactar diferentes aspectos da aprendizagem motora (REDGRAVE et al., 2010; MARINELLI et al., 2017).

Pessoas com DP conseguem aprender e manter habilidades motoras com a prática, mesmo que esse processo possa ocorrer de forma menos eficiente do que em pessoas saudáveis (NIEUWBOER et al., 2009). Os déficits de aprendizagem que se verificam na doença não ocorrem sempre da mesma maneira, dependendo do tipo de tarefa, da etapa do aprendizado, das instruções dadas, do uso de pistas externas e das exigências cognitivas (MARINELLI et al., 2017). Alterações cognitivas frequentemente observadas na DP, especialmente em funções executivas, atenção e memória, também podem impactar a maneira como novas habilidades motoras são aprendidas e refinadas (AARSLAND et al., 2021). Portanto, a aprendizagem motora na DP deve ser compreendida como um processo complexo, que depende das características da tarefa e das condições motoras e cognitivas do praticante.

2.4 Estratégias e condições de prática na aprendizagem motora da marcha na doença de Parkinson

Embora a repetição da prática e a intensidade do treinamento sejam componentes fundamentais para a aprendizagem motora e para os processos de

neuroplasticidade, diferentes estratégias podem influenciar a forma como as habilidades são adquiridas, refinadas e transferidas para contextos funcionais (KLEIM; JONES, 2008; MAGILL; ANDERSON, 2021). A neuroplasticidade refere-se à capacidade do sistema nervoso de modificar sua estrutura e função em resposta à experiência e à prática, constituindo um dos principais mecanismos biológicos que sustentam a aprendizagem motora (KLEIM; JONES, 2008). Nesse contexto, as estratégias de aprendizagem motora têm em comum o fato de modificar a maneira como a informação é apresentada, processada ou praticada durante o treinamento, direcionando a atenção, a interpretação das informações e a organização da prática, em vez de apenas aumentar o volume de exercício realizado.

2.4.1 Feedback aumentado

O feedback é um elemento essencial na aprendizagem motora por fornecer informações relevantes sobre o desempenho e os resultados da ação. Além das informações provenientes dos próprios sistemas sensoriais do praticante, a execução de uma tarefa pode envolver informações externas adicionais fornecidas por terapeutas, instrutores ou dispositivos tecnológicos. O feedback aumentado corresponde a informações suplementares fornecidas por uma fonte externa ao praticante com o objetivo de orientar, corrigir ou reforçar o desempenho durante a aprendizagem de uma habilidade motora (MAGILL; ANDERSON, 2021).

O feedback aumentado pode ser fornecido de diferentes formas, como instruções verbais, recursos visuais, sinais auditivos e tecnologias que disponibilizam informações sobre o desempenho ou os resultados da tarefa, como sistemas de biofeedback, exergames e esteiras instrumentadas. De modo geral, essa estratégia é dividida em conhecimento de resultados, relacionado ao desfecho da ação, e conhecimento de performance, que se refere às características da execução do movimento (MAGILL; ANDERSON, 2021).

Evidências sugerem que o feedback aumentado pode contribuir para melhorias em desfechos relacionados à marcha, ao equilíbrio e à função motora, especialmente quando fornecido em tempo real e integrado a recursos tecnológicos interativos. Além disso, a disponibilidade de informações externas adicionais pode auxiliar na compensação de déficits sensório-motores e favorecer o engajamento

durante a prática, contribuindo para os resultados da reabilitação motora (KEARNEY et al., 2020).

2.4.2 Foco externo e pistas sensoriais

O foco externo corresponde ao direcionamento da atenção para os efeitos do movimento no ambiente, enquanto as pistas sensoriais consistem em estímulos externos utilizados para facilitar o início e orientar a execução da tarefa motora (BECK et al., 2018; STONSAOVAPAK et al., 2026). Embora representem conceitos distintos, ambas utilizam referências externas ao indivíduo para influenciar o comportamento motor durante a prática. Por esse motivo, foram agrupadas na presente revisão em uma mesma categoria de aprendizagem motora. As pistas sensoriais podem ser auditivas, visuais ou somatossensoriais. As pistas auditivas fornecem referências rítmicas para auxiliar o controle temporal da marcha; as visuais oferecem referências espaciais para o ajuste do comprimento do passo e da trajetória do movimento; e as somatossensoriais disponibilizam informações táteis ou proprioceptivas relacionadas ao posicionamento corporal e à execução da tarefa (SUTEERAWATTANANON et al., 2004; STONSAOVAPAK et al., 2026).

Na DP, essas estratégias são amplamente utilizadas porque podem compensar déficits relacionados aos circuitos dos núcleos da base, favorecendo a utilização de informações externas para o planejamento e a execução do movimento. Evidências recentes demonstram efeitos positivos sobre parâmetros espaço-temporais da marcha. Em uma revisão sistemática com meta-análise em rede envolvendo 33 ensaios clínicos randomizados, pistas visuais e somatossensoriais apresentaram os melhores resultados para velocidade da marcha e comprimento do passo, superando os efeitos observados com pistas auditivas isoladas (STONSAOVAPAK et al., 2026).

2.4.3 Foco interno

Foco interno é a atenção voltada para os próprios movimentos corporais na realização de uma tarefa (BECK et al., 2018). Neste tipo de abordagem, as orientações são mais focadas em como os segmentos do corpo devem estar posicionados ou como o movimento deve ser executado. Portanto, o foco se volta

para aspectos da própria ação motora e para os movimentos gerados durante a execução da tarefa (BECK et al., 2018).

2.4.4 Observação da ação e imagética motora

A observação da ação e a imagética motora são estratégias de aprendizagem motora baseadas na representação mental do movimento. Na observação da ação, o indivíduo observa outra pessoa realizando uma tarefa motora, enquanto na imagética motora o movimento é mentalmente simulado sem que ocorra sua execução física (SARASSO et al., 2021). Embora distintas, ambas envolvem processos de representação motora e estão associadas à ativação de áreas corticais relacionadas ao planejamento, à organização e ao controle do movimento (SARASSO et al., 2021).

A observação da ação e a imagética motora podem ser utilizadas de forma isolada ou combinada durante o treinamento motor, constituindo estratégias voltadas à observação, representação e ensaio mental do movimento (SARASSO et al., 2021).

2.4.5 Condições de prática

Além das estratégias de aprendizagem motora, a forma como a prática é organizada também possui papel importante nesse processo. As condições de prática referem-se à maneira como as tarefas e exercícios são estruturados, influenciando a aquisição, retenção e transferência de habilidades motoras ao longo da prática (MAGILL; ANDERSON, 2021).

Diferentes condições de prática podem ser empregadas durante o treinamento, incluindo variabilidade, especificidade, simplificação e segmentação da tarefa. A variabilidade da prática envolve a realização de uma tarefa em diferentes contextos ou condições, favorecendo a adaptação do movimento a demandas variadas. A especificidade consiste em praticar a própria habilidade ou tarefas com características semelhantes àquelas encontradas na situação real de desempenho, aumentando a probabilidade de transferência dos ganhos obtidos durante o treinamento. A simplificação consiste na redução temporária da complexidade da tarefa, tornando-a mais acessível durante as fases iniciais da aprendizagem. Já a segmentação envolve a divisão de uma habilidade complexa em componentes

menores que podem ser praticados separadamente antes de serem integrados à tarefa completa.

Essas condições modificam a organização da prática, as características da tarefa e as demandas impostas ao indivíduo, permitindo que o processo de aprendizagem seja estruturado de acordo com os objetivos do treinamento e com as capacidades de cada indivíduo (MAGILL; ANDERSON, 2021).

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3. JUSTIFICATIVA

A DP é considerada uma condição neurodegenerativa complexa, com repercussões motoras, cognitivas e atencionais, que impactam de forma direta tanto a mobilidade quanto os processos envolvidos na aprendizagem motora. Embora indivíduos com DP já possuam a habilidade de caminhar, as alterações provocadas pela doença modificam a forma como essas pessoas caminham, reduzindo sua automaticidade e aumentando a dependência de recursos cognitivos. Portanto, a reabilitação da marcha não se resume a repetir exercícios, mas sim a utilizar estratégias que ajudem a construir novos recursos motores e comportamentais para enfrentar as dificuldades trazidas pela doença. Assim, variadas abordagens de aprendizagem motora e condições de prática podem influenciar como essas adaptações são desenvolvidas e incorporadas às atividades do cotidiano.

Embora exista um número crescente de estudos voltados à reabilitação da marcha na DP, ainda há uma importante lacuna nesse campo: os estudos frequentemente descrevem o tipo de treinamento realizado, mas raramente elucidam como o movimento é ensinado, quais estratégias de aprendizagem motora são utilizadas, como a prática é estruturada e se essas escolhas levam em consideração as particularidades motoras e cognitivas dos indivíduos com DP. Visto isso, ainda existe uma lacuna no entendimento de como os princípios da aprendizagem motora são utilizados nas intervenções de marcha e quais são os fundamentos que embasam essas escolhas. Assim, mapear, caracterizar e categorizar essas estratégias e condições de prática representa um passo importante para consolidar o conhecimento nessa área e permitir o desenvolvimento de intervenções mais personalizadas e fundamentadas nos processos de aprendizagem motora.

4. OBJETIVOS

4.1. Objetivo geral

Identificar, descrever e classificar as estratégias de aprendizagem motora e as condições de prática aplicadas nas intervenções de reabilitação da marcha em indivíduos com DP.

4.2. Objetivos específicos

a) Classificar as estratégias de aprendizagem motora identificadas nos estudos incluídos, agrupando-as em categorias conceituais relacionadas aos princípios da aprendizagem motora.
b) Identificar e categorizar as condições de prática empregadas nas intervenções, incluindo variabilidade, especificidade, simplificação e segmentação da tarefa;
c) Quantificar a frequência de utilização das diferentes estratégias de aprendizagem motora e condições de prática nos estudos incluídos;
d) Descrever a forma de implementação das estratégias de aprendizagem motora e das condições de prática, considerando modos de entrega, recursos utilizados e tipos de instrução reportados;
e) Examinar os padrões de utilização das estratégias de aprendizagem motora e das condições de prática reportados na literatura, discutindo suas possíveis implicações para a prática clínica e para futuras pesquisas.

5. CONSIDERAÇÕES FINAIS

O presente estudo permitiu identificar, descrever e categorizar as estratégias de aprendizagem motora e as condições de prática utilizadas em intervenções voltadas à reabilitação da marcha em pessoas com DP. Observou-se maior utilização de abordagens relacionadas ao fornecimento de informações externas, como feedback aumentado, foco externo e pistas sensoriais, bem como de diferentes condições de prática voltadas à organização do treinamento. Também foi observada considerável variabilidade na forma como essas estratégias são descritas e implementadas nos protocolos de intervenção.

Mais do que mapear quais estratégias têm sido utilizadas, esta dissertação contribui para ampliar a compreensão sobre como a aprendizagem motora tem sido incorporada à reabilitação da marcha em indivíduos com DP. Os achados reforçam a necessidade de que pesquisadores e profissionais não considerem apenas o que é treinado, mas também como o movimento é ensinado ao longo do processo de reabilitação. Considerando a heterogeneidade clínica da DP e as diferenças motoras e cognitivas presentes entre os indivíduos, compreender as estratégias empregadas e a forma como são implementadas representa um passo importante para o desenvolvimento de intervenções mais individualizadas, fundamentadas nos princípios da aprendizagem motora e alinhadas às necessidades específicas de cada paciente.

6. ANEXOS

Normas para submissão do periódico *Parkinsonism and Related Disorders* (Fator de impacto 3.4)

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- Definitions of sex and/or gender applied should be explicitly stated to enhance the precision, rigor and reproducibility of the research and to avoid ambiguity or conflation of terms and the constructs to which they refer.

We advise you to read the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER checklist (PDF) on the EASE website, which offer systematic approaches to the use of sex and gender information in study design, data analysis, outcome reporting and research interpretation.

For further information we suggest reading the rationale behind and recommended use of the SAGER guidelines.

Definitions of sex and/or gender

We ask authors to define how sex and gender have been used in their research and publication. Some guidance:

- Sex generally refers to a set of biological attributes that are associated with physical and physiological features such as chromosomal genotype, hormonal levels, internal and external anatomy. A binary sex categorization (male/female) is usually designated at birth ("sex assigned at birth") and is in most cases based solely on the visible external anatomy of a newborn. In reality, sex categorizations include people who are intersex/have differences of sex development (DSD).

- Gender generally refers to socially constructed roles, behaviors and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time. Gender influences how people view themselves and each other, how they behave and interact and how power is distributed in society.

Depending on the focus of a paper, sex and/or gender may or may not be relevant to the content of the paper. We recognize that beliefs, attitudes, and laws relating to sex and gender may vary. These articles do not attempt to dictate author beliefs but rather require that, where relevant to an author's research or paper, the author must provide clear explanations of how the paper and research define and use sex and gender.

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- Institutional affiliations: Authors should use either the full, standard title of their institution or the standard abbreviation of the institutional name so that the institutional name can be independently verified for research integrity purposes.

Studies in humans

Authors must follow ethical guidelines for studies carried out in humans.

Work which involves the use of human subjects should be carried out in accordance with the World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects.

Manuscripts should follow the International Committee of Medical Journal Editors (ICMJE) recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals and aim to be representative of human populations in terms of sex, age and ethnicity. Sex and gender terms should be used correctly, as outlined by WHO (World Health Organization).

Manuscripts must include a statement that all procedures were performed in compliance with relevant laws and institutional guidelines and have been approved by the appropriate institutional committee(s). The statement should contain the date and reference number of the ethical approval(s) obtained.

Manuscripts must also include a statement that the privacy rights of human subjects have been observed and that informed consent was obtained for experimentation with human subjects.

This journal will not accept manuscripts that contain data derived from unethically sourced organs or tissue, including from executed prisoners or prisoners of conscience, consistent with recommendations by Global Rights Compliance on Mitigating Human Rights Risks in Transplantation Medicine. For all studies that use human organs or tissues, sufficient evidence must be provided that these were procured in line with WHO Guiding Principles on Human Cell, Tissue and Organ Transplantation. For clinical studies, a statement of informed consent having been obtained from a patient or their nominated representative, paired with ethical approval for the study from a suitable institution, as required by the policies of the journal, may be considered sufficient evidence, but the journal reserves the right to request additional evidence in cases where it feels this is not sufficient. The source of the organs or tissues used in clinical research must be transparent and traceable. If your manuscript describes organ transplantation you must additionally declare within the manuscript that:

- autonomous consent free from coercion was obtained from the donor(s) or their next of kin.

- organs and/or tissues were not sourced from executed prisoners or prisoners of conscience.

Studies in animals

Authors must follow ethical guidelines for studies carried out in animals.

All animal experiments should comply with ARRIVE (Animal Research: Reporting of In Vivo Experiments) guidelines.

Studies should be carried out in accordance with Guidance on the operation of the Animals (Scientific Procedures) Act 1986 and associated guidelines, EU Directive 2010/63 for the protection of animals used for scientific purposes or the NIH (National Research Council) Guide for the Care and Use of Laboratory Animals (PDF).

A statement should be included in your manuscript that such guidelines as listed above have been followed.

The sex of animals, and where appropriate, the influence (or association) of sex on the results of the study must be indicated.

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Authors must document in the manuscript that ethics committee approval and informed consent have been obtained for studies involving patients or volunteers (including organ/tissue donors). Key guidelines:

- Appropriate consents, permissions and releases must be obtained if case details, personal information and images of patients or any other individuals are included in a publication, even if anonymized.
- Patient and research subjects' names, initials, hospital or social security numbers, dates of birth or any other personal or identifying information should never be used, even where consent has been provided.

Written consents must be retained. They should not be provided to this journal unless this is specifically requested in exceptional circumstances, for example, when a legal issue arises. Only then should you provide copies of the consents, or evidence that all relevant consents were obtained.

Personal details of any patient must only be included in your article or in any supplementary materials (including all images and videos) in cases where written permission has been given by the patient (or, where applicable, the next of kin).

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For case reports you are required to follow CARE guidelines and provide the CARE checklist at manuscript submission.

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We ask you to provide editable source files for your entire submission (including figures, tables and text graphics). Some guidelines:

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- Author names. Provide the given name(s) and family name(s) of each author. The order of authors should match the order in the submission system. Carefully check that all names are accurately spelled. If needed, you can add your name between parentheses in your own script after the English transliteration.
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You are required to provide a concise and factual abstract which does not exceed 250 words. The abstract should briefly state the purpose of your research, principal results and major conclusions. Some guidelines:

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- Avoid references. If any are essential to include, ensure that you cite the author(s) and year(s).
- Avoid non-standard or uncommon abbreviations. If any are essential to include, ensure they are defined within your abstract at first mention.

Structured abstract

A structured abstract, by means of appropriate headings, should provide the context or background for your research. Some guidelines:

- State the purpose of your research.
- Outline basic procedures followed such as the selection of study subjects or laboratory animals and observational and analytical methods.
- Include your main findings, providing specific effect sizes and their statistical significance, if possible, and your principal conclusions.
- Emphasize new and important aspects of your study or observations.

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You are encouraged to provide article highlights at submission.

Highlights are a short collection of bullet points that should capture the novel results of your research as well as any new methods used during your study. Highlights will help increase the discoverability of your article via search engines. Some guidelines:

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You are encouraged to provide a graphical abstract at submission.

The graphical abstract summarizes the contents of your article in a concise, pictorial, professional form, highlighting important aspects of the research. It is designed to appeal to an interdisciplinary audience, and draw more attention to your online article. Some guidelines:

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More information, examples and a template can be found in the graphical abstract guidelines.

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Tables must be submitted as editable text, not as images. Some guidelines:

- Place tables next to the relevant text or on a separate page(s) at the end of your article.
- Cite all tables in the manuscript text.
- Number tables consecutively according to their appearance in the text.
- Please provide captions along with the tables.
- Place any table notes below the table body.
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We recommend that you use tables sparingly, ensuring that any data presented in tables is not duplicating results described elsewhere in the article.

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Figures, images, artwork, diagrams and other graphical media must be supplied as separate files along with the manuscript. We recommend that you read our detailed artwork and media instructions. Some excerpts:

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All images must have a caption. A caption should consist of a brief title (not displayed on the figure itself) and a description of the image. We advise you to keep the amount of text in any image to a minimum, though any symbols and abbreviations used should be explained.

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When your artwork is finalized, "save as" or convert your electronic artwork to the formats listed below taking into account the given resolution requirements for line drawings, halftones, and line/halftone combinations:

- Vector drawings: Save as EPS or PDF files embedding the font or saving the text as "graphics."

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We encourage the use of supplementary materials such as applications, images and sound clips to enhance research. Some guidelines:

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We are committed to supporting the storage of, access to and discovery of research data, and our research data policy sets out the principles guiding how we work with the research community to support a more efficient and transparent research process.

Research data refers to the results of observations or experimentation that validate research findings, which may also include software, code, models, algorithms, protocols, methods and other useful materials related to the project.

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For this journal, **Option B** instructions from our research data guidelines apply. This means that you are **encouraged** to:

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Include any individuals who provided you with help during your research, such as help with language, writing or proof reading, in the acknowledgements section.

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Abbreviate journal names according to the List of Title Word Abbreviations (LTWA).

Examples:

Reference to a journal publication:

[1] J. van der Geer, T. Handgraaf, R.A. Lupton, The art of writing a scientific article, J. Sci. Commun. 163 (2020) 51 – 59. https://doi.org/10.1016/j.sc.2020.00372.

Reference to a journal publication with an article number:

[2] J. van der Geer, T. Handgraaf, R.A. Lupton, 2022. The art of writing a scientific article. Heliyon. 19, e00205. https://doi.org/10.1016/j.heliyon.2022.e00205.

Reference to a book:

[3] W. Strunk Jr., E.B. White, The Elements of Style, fourth ed., Longman, New York, 2000.

Reference to a chapter in a book:

[4] G.R. Mettam, L.B. Adams, How to prepare an electronic version of your article, in: B.S. Jones, R.Z. Smith (Eds.), Introduction to the Electronic Age, E-Publishing Inc., New York, 2020, pp. 281 – 304.

Reference to a website:

[5] Cancer Research UK, Cancer statistics reports for the UK. http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/, 2023 (accessed 13 March 2023).

Reference to a dataset:

[6] M. Oguro, S. Imahiro, S. Saito, T. Nakashizuka,Mortality data for Japanese oak wilt disease and surrounding forest compositions [dataset], Mendeley Data, v1, 2015. https://doi.org/10.17632/xwj98nb39r.1.

Reference to software:

[7] E. Coon, M. Berndt, A. Jan, D. Svyatsky, A. Atchley, E. Kikinzon, D. Harp, G. Manzini, E. Shelef, K. Lipnikov, R. Garimella, C. Xu, D. Moulton, S. Karra, S. Painter, E. Jafarov, S. Molins, Advanced Terrestrial Simulator (ATS) v0.88 [software], Zenodo, March 25, 2020. https://doi.org/10.5281/zenodo.3727209.

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