

**UNIVERSIDADE FEDERAL DE CIÊNCIAS DA SAÚDE DE  
PORTO ALEGRE**

**CURSO DE FISIOTERAPIA**

**Natália Lopes Mazzilli**

**O uso da interface cérebro-máquina,  
da imaginação motora e da**

**observação da ação na reabilitação  
de indivíduos com Doença de**

**Parkinson: estudo protocolo para  
Universidade Federal de Ciências da Saúde  
de Porto Alegre  
um ensaio clínico randomizado**

Porto Alegre

2024

**Natália Lopes Mazzilli**

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Trabalho de Conclusão de Curso de Fisioterapia, da Universidade Federal de Ciências da Saúde de Porto Alegre, como requisito parcial para obtenção do título de Bacharel em Fisioterapia.

Orientador: Profa. Dra. Fernanda Cechetti

Co-orientador: Tatiana Pettenuzzo

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NATÁLIA LOPES MAZZILLI

**O USO DA INTERFACE CÉREBRO-MÁQUINA, DA IMAGINAÇÃO MOTORA E DA OBSERVAÇÃO DA AÇÃO NA REABILITAÇÃO DE INDIVÍDUOS COM DOENÇA DE PARKINSON: ESTUDO PROTOCOLO PARA UM ENSAIO CLÍNICO RANDOMIZADO**

Trabalho final, apresentado a Universidade Federal de Ciências da Saúde de Porto Alegre, como parte das exigências para a obtenção do título de Bacharel em Fisioterapia.

Porto Alegre, 3 de dezembro de 2024.

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Prof.<sup>(a)</sup> KÁTIA DANIELE RECH

Dedico este trabalho aos meus pais e a todos os meus familiares, que me inspiraram e me apoiaram durante toda essa trajetória acadêmica. Ao meu pai, em especial, que por casualidade do destino, me fez acreditar no potencial e na grandeza deste curso. E aos meus professores e amigos que me orientaram e me incentivaram a chegar até o fim desta jornada.

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## RESUMO

**Contexto:** O comprometimento dos membros superiores é uma das principais queixas de indivíduos com Doença de Parkinson (DP). A imaginação motora (IM) e a observação da ação (OA), associadas ou não a interface cérebro-máquina (ICM), têm sido aplicadas na reabilitação de pessoas com distúrbios neurológicos. Contudo, são escassos os estudos que detalham a aplicação dessas técnicas especificamente na DP. **Objetivo:** Este estudo visa descrever detalhadamente o protocolo de um ensaio clínico randomizado simples cego para avaliar os efeitos das intervenções isoladas e combinadas de IM, OA e ICM nas alterações motoras dos membros superiores e na função cognitiva em indivíduos com DP. **Métodos:** O estudo será conduzido com cinco grupos experimentais: IM, OA e execução da ação; IM e execução da ação; OA e execução da ação; IM via ICM e execução da ação; IM via ICM, OA e execução da ação. A amostra será composta por indivíduos com DP, recrutados por conveniência, e distribuídos aleatoriamente entre os grupos. Cada participante será avaliado em três momentos: pré-intervenção (T0), pós-intervenção (T1) e no *follow-up* (T2), quatro semanas após o término da intervenção. A intervenção consistirá em 10 sessões, com duração aproximada de 60 minutos cada. **Resultados esperados:** Os resultados esperados incluem melhorias no desempenho motor, avaliadas pelo Teste de Avaliação dos Membros Superiores de Pessoas Idosas e pela Escala Unificada de Avaliação da Doença de Parkinson - Parte III, além de uma redução no tempo de execução da tarefa no Teste dos 9 Pinos. A função cognitiva será avaliada pela Escala de Avaliação Cognitiva da DP, e o desempenho ocupacional pela Medida Canadense de Desempenho Ocupacional. **Discussão:** Considera-se que a elaboração deste protocolo facilitará a reprodução dessas técnicas na reabilitação de pessoas com DP. O protocolo destaca-se pela personalização das intervenções e pela possibilidade de aplicação fora do ambiente clínico, podendo ser facilmente replicada por fisioterapeutas e terapeutas ocupacionais, resultando em uma proposta inédita e inovadora para essa população. O estudo está registrado no Clinicaltrials.gov sob o ID NCT05696925.

**Palavras-chave:** Imaginação motora, observação da ação, interface cérebro-máquina, Doença de Parkinson, estudo protocolo.

## ABSTRACT

**Background:** Upper limb impairment is one of the main complaints of individuals with Parkinson's disease (PD). Motor imagery (MI) and action observation (AO), with or without the use of brain-machine interfaces (BMI), have been applied in the rehabilitation of individuals with neurological disorders. However, there are few studies that detail the application of these techniques specifically for PD. **Objective:** This study aims to provide a detailed description of the protocol for a simple, single-blind randomized clinical trial to evaluate the effects of isolated and combined MI, AO, and BMI interventions on motor changes in the upper limbs and cognitive function in individuals with PD. **Methods:** The study will be conducted with five experimental groups: MI, AO, and action execution; MI and action execution; AO and action execution; MI via BMI and action execution; MI via BMI, AO, and action execution. The sample will consist of individuals with PD, recruited by convenience sampling, and randomly assigned to the groups. Each participant will be assessed at three time points: pre-intervention (T0), post-intervention (T1), and at follow-up (T2), four weeks after the intervention ends. The intervention will consist of 10 sessions, each lasting approximately 60 minutes. **Expected results:** Expected outcomes include improvements in motor performance, assessed by the Upper Limb Functional Test for Older Adults and the Unified Parkinson's Disease Rating Scale (UPDRS) - Part III, as well as a reduction in task execution time on the Nine-Hole Peg Test. Cognitive function will be assessed using the Parkinson's Disease Cognitive Rating Scale, and occupational performance will be measured by the Canadian Occupational Performance Measure. **Discussion:** It is expected that the development of this protocol will facilitate the replication of these techniques in the rehabilitation of individuals with PD. The protocol stands out for the customization of the interventions and the possibility of being applied outside the clinical environment, making it easily replicable by physiotherapists and occupational therapists, resulting in an innovative and unprecedented proposal for this population. The study is registered on Clinicaltrials.gov under the ID NCT05696925.

**Key words:** Motor imagery, action observation, brain-computer interface, Parkinson's Disease, study protocol.

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## **LISTA DE ABREVIATURAS E SIGLAS**

PD – Parkinson's disease

UL – Upper limbs

MI – Motor imagery

AO – Action observation

BMI – Brain-machine interfaces

EEG – Electroencephalogram

AE - Action execution

MoCA - Montreal Cognitive Assessment

KVIQ-10 - Kinesthetic and Visual Imagery Questionnaire

9HPT - Nine-Hole Peg Test

TEMPA - Test D'évaluation Des Membres Supérieurs Des Personnes Âgées

UPDRS-III - Unified Parkinson's Disease Rating Scale - part III

PD-CRS - Parkinson's disease -Cognitive Rating Scale

COPM - Canadian Occupational Performance Measure

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## **Supporting information captions**

# ANEXO

## ANEXO A

### NORMAS DA REVISTA PLOS ONE PARA SUBMISSÃO DO ARTIGO



#### MANUSCRIPT BODY FORMATTING GUIDELINES

Modified April 2021

## 1 Abstract

2 Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
3 Vestibulum adipiscing urna ut lectus gravida, vitae blandit tortor  
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5 pharetra quam, vitae convallis nunc. Mauris in mattis sapien. Fusce  
6 sodales vulputate auctor. Nam lacus felis, fermentum sit amet nulla  
7 ac, tristique ultrices tellus. Integer rutrum aliquet sapien, eu  
8 fermentum magna pellentesque vitae. Integer semper viverra mauris  
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11 ante, fringilla quis tortor sit amet, accumsan fermentum quam. Nulla  
12 dictum consectetur leo. Ut vulputate ipsum purus, a interdum nibh  
13 viverra et. Praesent aliquam sapien vel massa sodales bibendum.  
14 Nulla interdum accumsan lectus, sed auctor elit accumsan a.  
15 Suspendisse quis rhoncus nibh. The verum est de illic.

16 **NOTE: Before submitting, review the full submission guidelines**  
17 **for the journal to which you are submitting:** [PLOS ONE](#), [PLOS](#)  
[Biology](#), [PLOS Medicine](#), [PLOS Neglected Tropical Diseases](#), [PLOS](#)  
[Computational Biology](#), [PLOS Genetics](#), [PLOS Pathogens](#)

## 18 Introduction

19 Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
20 Vestibulum adipiscing urna ut lectus gravida, vitae blandit tortor  
21 interdum. Donec tincidunt porta sem nec hendrerit. Vestibulum nec  
22 pharetra quam, vitae convallis nunc.

## 23 Level 1 heading

24 Lorem ipsum dolor sit amet, consectetur adipiscing elit.  
25 Vestibulum adipiscing urna ut lectus gravida, vitae (Fig 1)  
26 interdum. Donec tincidunt porta sem nec hendrerit. Vestibulum nec  
27 pharetra quam, vitae convallis nunc. Mauris in mattis sapien. Fusce  
28 sodales vulputate auctor. Nam sit amet nulla lacus a, (Figs 1 and 2)  
29 ultrices tellus. Integer rutrum aliquet sapien, eu fermentum magna  
30 pellentesque vitae.

31  
32 **Fig 1. This is the Fig 1 Title.** This is the Fig 1 legend.

33 **Fig 2. This is the Fig 2 Title.** This is the Fig 2 legend.

### 34 File Naming for Figures

- Figure files should be saved as "Fig1.tif", "Fig2.eps", etc.
- Acceptable file formats for figures are ".tif", ".tiff", and ".eps"
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### Level 1 Heading

- Use Level 1 heading for all major sections (Abstract, Introduction, Materials and methods, Results, Discussion, etc.).
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### Figure Citations

- Cite figures as "Fig 1", "Fig 2", etc.
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- Do not cite "Fig 2" before "Fig 1".
- Cite multiple figures as "Figs 1 and 2", "Figs 1-3", etc.

### Figure Captions

- Each figure caption should appear directly after the paragraph in which they are first cited.
- Do not include tables within captions.
- Use bold type for the figure titles.

84

85

## 86 Acknowledgments

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## 92 References

- 93 1. Doe J, Data A, van Stats J, Testperson M, Ribosome D Jr,  
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 98 PLoS ONE. Forthcoming 2017.

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