A study protocol for a randomized controlled trial of a handwriting rehabilitation intervention in adults with Parkinson disease

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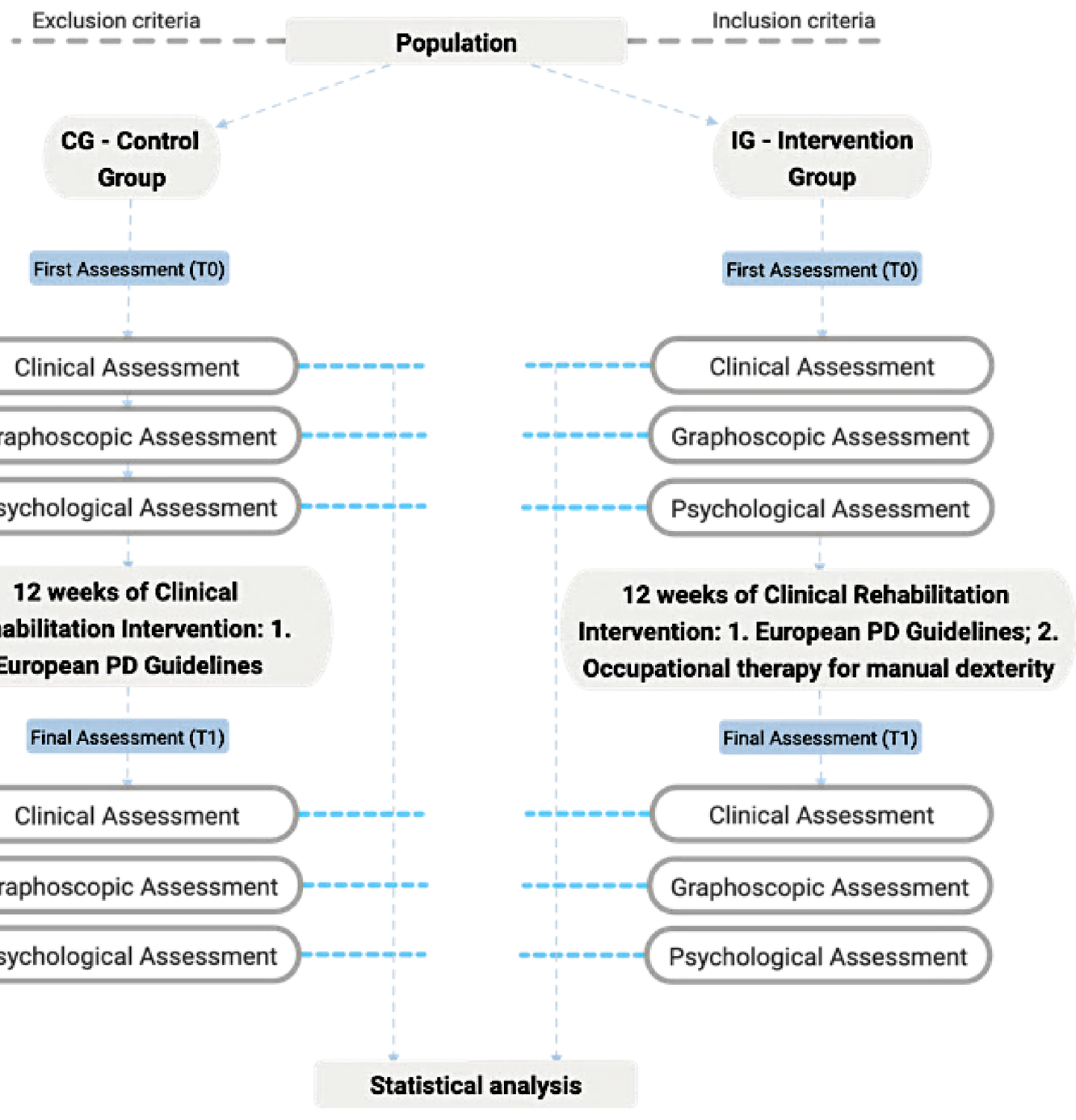
INTRODUCTION

Graphoscopic analysis examines handwriting to identify unique graphic identities, crucial in legal contexts (Robles & Ramos, 2009). Handwriting, shaped by complex learning and motor automation, serves as a reliable biometric tool (Fernandes, 2010). Digital handwriting analysis offers a non-invasive method to monitor PD progression (He et al., 2021), while rehabilitation therapies help preserve motor skills and handwriting performance (Foster et al., 2021).

OBJECTIVE: The present protocol proposal aims to characterize and compare handwriting dynamic characteristics, before and after the implementation of a traditional physiotherapy rehabilitation program and a occupational therapy rehabilitation program, in Parkinson's disease.

PROTOCOL PROPOSAL



1. **Approvals and Ethics**

2. **Population and Procedure**
Participants will be recruited through the Portuguese Parkinson Association (APDPk), Clínica Neurovida, Hospital Garcia de Orta, Egas Moniz Physiotherapy Clinic, and the Young Parkies Portugal group. Eligible candidates (Hoehn & Yahr stages 2–3, minimum education level of 4th grade, native Portuguese speakers) will be invited following an initial clinical diagnosis. Exclusion criteria included physical or mental conditions that could impact handwriting or the nervous system.

3. **Rehabilitation Programs (12 weeks)**
- **Traditional Physiotherapy Rehabilitation Program (TPRP)**: 1-hour sessions twice per week, following the European Physiotherapy Guideline for Parkinson's Disease (Keus et al., 2014; Osborne et al., 2022).
- **Occupational Therapy Rehabilitation Program (OTRP)**: Workbook exercises (e.g., letter tracing, sentence writing) and fine motor tasks (e.g., hand manipulation, finger isolation) for 30 minutes, three times per week (adapted from Aragon & Kings, n.d.).

4. **Outcome Measures (Baseline T0 - 12 weeks T1)**
Handwriting Sample Collection: Digital surface (Wacom One 13' with MovAlyzeR v6.1 software).
Dynamic features: Absolute Size, Average Absolute Velocity, Average Pen Pressure, Duration, Horizontal, Size, Move Vel, Normalized Jerk, Vertical, Size, Number Of Peak Acceleration and Relative Pen Down Duration)

Motor Function Assessment (MDS-UPDRS (Collett et al., 2017b) and Jebsen-Taylor (Fabbri et al., 2021) tests)

Psychological Assessment (Mini-Mental State Examination - MMSE (Guerreiro, 1994; Scheffels et al., 2020), Geriatric Depression Scale - GDS (Yesavage et al., 1983) and SF-36 Health Survey (Ware & Ware, 1992))

5. **Statistical Analysis (R Studios)**
Linear mixed models and Shapiro–Wilk and the Breush–Pagan tests.

CONCLUSION

This study aims to determine whether there are differences in the dynamic features of handwriting before and after implementing a specific rehabilitation program for Parkinson's disease (traditional physiotherapy rehabilitation program vs occupational therapy rehabilitation program) and explore disease severity, cognitive state, and levels of depression, resulting from disease progression and rehabilitation, relationships with handwriting ability, specifically in dynamic features.

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REFERENCES

Aragon, A., & Kings, J. (n.d.). Occupational therapy for people with Parkinson's Second edition. www.rcot.co.uk/publications
Collett, J., Franssen, M., Winward, C., Izadi, H., Meaney, A., Mahmoud, W., Bogdanovic, M., Tims, M., Wade, D., & Dawes, H. (2017b). A long-term self-managed handwriting intervention for people with Parkinson's disease: results from the control group of a phase II randomized controlled trial. Clinical Rehabilitation, 31(12), 1636–1645. https://doi.org/10.1177/0269215517711232
Fabbri, B., Berardi, A., Tofani, M., Panuccio, F., Ruotolo, I., Sellitto, G., & Galeoto, G. (2021). A systematic review of the psychometric properties of the Jebsen–Taylor Hand Function Test (JTHFT). In Hand Surgery and Rehabilitation (Vol. 40, Issue 5, pp. 560–567). Elsevier Masson s.r.l. https://doi.org/10.1016/j.hansur.2021.05.004
Fernandes, C. A. P. (2010). A influência da doença de Alzheimer na escrita manual. Universidade do Porto.
Foster, E. R., Carson, L. G., Archer, J., & Hunter, E. G. (2021). Occupational therapy interventions for instrumental activities of daily living for adultswith parkinson's disease: A systematic review. In American Journal of Occupational Therapy (Vol. 75, Issue 3). American Occupational Therapy Association, Inc. https://doi.org/10.5014/ajot.2021.046581
Guerreiro M, S. A. B. M. L. O. C.-C. A. G. C. (1994). Adaptação à população portuguesa da tradução do Mini Mental State Examination. Revista Portuguesa de Neurologia.
He, Y., Tian, Y., Han, H., Cui, J., Ge, X., Qin, Y., Luo, Y., Bai, W., & Yu, H. (2021). The path linking disease severity and cognitive function with quality of life in Parkinson's disease: the mediating effect of activities of daily living and depression. Health and Quality of Life Outcomes, 19(1). https://doi.org/10.1186/s12955-021-01740-w
Keus, S., Munneke, M., Graziano, M., Paltamaa, J., Pelosin, E., Domingos, J., Brühlmann, S., Ramaswamy, B., Prins, J., Struiksma, C., Rochester, L., Nieuwboer, A., & Bloem, B. (2014). European Physiotherapy Guideline for Parkinson's Disease Developed with twenty European professional associations. www.parkinsonnet.info/euguideline
Osborne, J. A., Botkin, R., Colon-Semenza, C., Deangelis, T. R., Gallardo, O. G., Kosakowski, H., Martello, J., Pradhan, S., Rafferty, M., Readinger, J. L., Whitt, A. L., & Ellis, T. D. (2022). Physical Therapist Management of Parkinson Disease: A Clinical Practice Guideline From the American Physical Therapy Association. In Physical Therapy (Vol. 102, Issue 4). Oxford University Press. https://doi.org/10.1093/ptj/pzab302
Robles, L. M., & Ramos, A. V. (2009). Grafoscopia y Perícia Caligráfica Forense (Bosch, Ed.). Editorial Bosch.
Ware, J. E., & Ware, J. (1992). Estimation of medical care total expenditures View project. http://www.fasttrackproject.org
Yesavage, J. A., Brink, T. L., Rose, T. L., Virwnia, H. ;, Adfy, M., & Leirer, V. O. (1983). DEVELOPMENT AND VALIDATION OF A GERIATRIC DEPRESSION SCREENING SCALE: A PRELIMINARY REPORT. In J. psychial. Rex (Vol. 17).