

Effects of mental practice strategies associated with physical therapy on gait and risk of falls in Parkinson disease: experimental study

Efeitos das estratégias de prática mental associadas à fisioterapia sobre a marcha e risco de quedas na doença de Parkinson: estudo experimental

 Liliane Pereira da Silva¹,  Taís Arcanjo Maropo da Silva¹,  Kássia Maria Clemente da Silva¹,  Suzana Pereira dos Santos¹,
 Douglas Monteiro da Silva¹,  Carla Cabral dos Santos Accioly Lins¹,  Maria das Graças Wanderley de Sales Coriolano¹,
 Otávio Gomes Lins¹

ABSTRACT

Objective: To compare the effects of mental practice (MP) strategies associated with physical therapy on gait and risk of falls in people with Parkinson's disease (PD). **Method:** We included 35 people of both sexes with mild to moderate idiopathic PD allocated into four groups: 1- Control group (CG), 2- Image-guided mental practice group (IGMP), 3- Audio-guided mental practice group (AGMP) and 4- Unguided mental practice group (UMP). The subjects in the experimental groups underwent 15 sessions of motor physical therapy and mental practice, while the CG received only physical therapy. The sessions were held twice a week, 40 minutes for motor physical therapy and 1 minutes for the corresponding Mental Practice protocol. To evaluate the spatiotemporal parameters of the gait, the 10-meter Walking Test was used and the risk of falls using the Timed Up and Go (TUG). **Results:** The IGPM group presented significant results for the time ($p=0.027$) and gait speed ($p=0.025$) when compared to the results of the CG. Cadence and risk of falls had no major effect for the group. The UMP and AGMP groups did not present statistically significant results for TC10m and TUG when compared with CG. **Conclusion:** The results of this study suggest that image-guided mental practice training associated with motor physical therapy is more effective in increasing gait speed than other MP strategies.

Keywords: Parkinson Disease, Accidental Falls, Gait, Imagination

RESUMO

Objetivo: Comparar os efeitos das estratégias de prática mental (PM) associadas à fisioterapia sobre a marcha e o risco de quedas em pessoas com doença de Parkinson (DP). **Método:** Incluímos 35 pessoas de ambos os sexos com DP idiopática leve a moderada alocadas em quatro grupos; 1- Grupo controle (GC), 2- Grupo de prática mental guiada por imagem (GPMI), 3- Grupo de prática mental guiada por áudio (GPMA) e 4- Grupo de prática mental sem guia (GPMSG). Os sujeitos dos grupos experimentais realizaram 15 sessões de fisioterapia motora e prática mental, enquanto o GC recebeu apenas fisioterapia. As sessões eram realizadas duas vezes por semana, sendo 40 minutos para fisioterapia motora e 1 minutos para o protocolo de Prática Mental correspondente. Para avaliar os parâmetros espaço-temporais da marcha, foi utilizado o Teste de Caminhada de 10 metros e para avaliar o risco de quedas foi utilizado o Timed Up and Go (TUG). **Resultados:** O grupo GPMI apresentou resultados significativos para o tempo ($p=0,027$) e velocidade da marcha ($p=0,025$) quando comparados aos resultados do GC. A cadência e o risco de quedas não apresentaram resultados significativos. Os grupos GPMSG e GPMA não apresentaram resultados estatisticamente significativos para TC10m e TUG quando comparados ao GC. **Conclusão:** Os resultados deste estudo sugerem que o treinamento da prática mental orientada por imagem associado à fisioterapia motora é mais eficaz para aumentar a velocidade da marcha do que outras estratégias de PM.

¹ Universidade Federal de Pernambuco - UFPE


Address for correspondence

Liliane Pereira da Silva
 E-mail: pereiradasilva20@hotmail.com

Submitted: January 5, 2021
 Accepted: December 21, 2021

How to cite

Silva LP, Silva TAM, Silva KMC, Santos SP, Silva DM, Lins CCSA, et al. Effects of mental practice strategies associated with physical therapy on gait and risk of falls in Parkinson disease: experimental study. *Acta Fisiatr.* 2021;28(4):268-273.

 10.11606/issn.2317-0190.v28i4a180627



©2021 by Acta Fisiátrica

This work is licensed under a Creative Commons - Attribution 4.0 International

Palavras-chaves: Doença de Parkinson, Acidentes por Quedas, Marcha, Imaginação

INTRODUCTION

Parkinson's Disease (PD) is a disabling chronic degenerative disorder that interferes with voluntary and automatic movements due to a dysfunction of the base nuclei caused by dopamine deficiency. Therefore, several motor impairments occur, including hypometry (decreased range of motion), bradykinesia (slowness of movement), postural instability (balance disorders), muscle stiffness and tremor at rest that impair the gait of PD patients and increase the risk of falling.¹

Gait in PD is characterized by a tendency to anterior trunk flexion, restriction of upper limb balance, reduced step length and, mainly, decreased walking speed. As gait disturbances are associated with a tendency to fall and reduced independence, great efforts are directed towards the treatment of these changes.²

Physical therapy is recommended as a complementary therapy to the clinical treatment of PD patients, since its main objective is to preserve motor function and functional independence.³

The association of mental practice (MP) with physical therapy to optimize motor learning in PD patients, has been suggested.⁴ MP is defined as the repetition of a movement or task using imagination and can be performed through kinesthetic or visual imagination. In kinesthetics, the patient imagines the sensation that is experienced when the actual movement happens. In visual the patient mentally visualizes the imagined movement, as if watching a movie of himself.⁴

The results of MP research in PD are still ambiguous due to several reasons such as the diversity of intervention protocols.³ Moreover, studies on the subject are scarce and limit the results interpretation.⁵

OBJECTIVE

Referring to what was said, the objective of this study is to compare the effects of MP strategies associated with physical therapy on gait and risk of falls of people with PD.

METHODS

Study design and ethical considerations

Experimental study approved by the Human Research Ethics Committee of the Federal University of Pernambuco (CEP nº. 2.294.139; in accordance with the World Ethics Code Medical Association (Declaration of Helsinki).

Place and a period

The study was conducted at a reference University Hospital in Pernambuco-Brazil from October 2017 to February 2019 in partnership with the Pro-Parkinson Extension and Research Program.

Sample, Allocation and Randomization

Convenience sample. The selected participants were allocated into four experimental groups: 1- Control group (CG), 2- Image-guided mental practice group (IGMP), 3- Audio-guided mental practice group (AGMP) and 4- Unguided mental practice group (UMP) using a random number sequence generated by randomization.com. The evaluations and reassessments were performed by a researcher "A" who was

unaware of the groups to which the patients belonged.

Eligibility

We included participants of both genders with a clinical diagnosis of idiopathic PD according ordinance of the 10/2017 from the Brazilian Ministry of Health,⁶ in the stages I to III.⁷ Patients with other neurological diseases, musculoskeletal, visual or auditory disorders that prevented the protocol were excluded, as well as the lowering of the cognitive level assessed through the Mini Mental State Examination with cutoff according to education level.⁸⁻¹⁰ Moderate to severe depression assessed by the Beck¹¹ Depression Inventory, participation in rehabilitation program and those with average score of kinesthetic and visual imagination questionnaire¹² <2 (reduced imagination).

Medical screening and evaluation procedure

The initial screening took place during the routine consultation at the neurology outpatient clinic where socio-demographic and clinical data, cognitive status, mood and the participants imagination were collected. After this procedure, the stage of the disease was assessed (in the off phase) and the assessment tools were applied.

Assessment tools

Used were the 10-meter Walk Test (WT10m)¹³ to assess the spatiotemporal gait parameters and the Timed Up and Go (TUG)¹⁴⁻¹⁶ to assess the risk of falls.

WT10m

The spatial and temporal kinematic attributes of the gait were evaluated by means of this test, which requires a 10-meter (m) straight walk, with 2m reserved for acceleration, 6m for comfortable walking and 2m for deceleration: speed and cadence to travel 6m. The best performance among three measures was considered for analysis.¹³

TUG

To assess the risk of falls, the TUG was used. Patients were instructed to get up from a chair, walk three meters, turn around, return, and sit in the chair. Performing the test in less than 10 seconds indicates low risk of falls and independent individuals with unchanged functional mobility, 10-20 seconds, medium risk of falls, and individuals with independence in basic transfers and above 20 seconds, high risk of falls and individuals with impaired functional independence. The TUG was performed once for patient familiarization and later three more times, being the best performance considered for analysis.¹⁴⁻¹⁶

The test was selected based on the European Physiotherapy Guideline for Parkinson's disease.¹⁷ TUG is a recommended instrument for assessing balance in Parkinson's Disease, being considered a valid and reliable instrument for patients with PD.

Intervention

Patients allocated to the MP groups underwent 15 physical therapy sessions associated with gait MP. The sessions took place twice a week, being 40 minutes for physiotherapy and 1 minute for the execution of the MP that took place in a quiet room immediately after physiotherapy.

CG patients received only physiotherapy. After completion of the 15 sessions, patients were reevaluated on the day following the last session.

Physical therapy protocol common to groups

The physiotherapy protocol common to the groups was developed by the Pro-Parkinson Program, based on the European physiotherapy guideline for PD, aiming to standardize the practice of evidence-based physiotherapy.¹⁷ The protocol consisted of nine exercises divided into three levels of difficulty (level progression every 5 sessions).

Each physiotherapy session consisted of exercises that included: position change training, strengthening (with emphasis on lower limbs); reach exercises, scapular and pelvic girdle dissociation exercises, core control training, balance, self-perception, gait and step training.

MP Protocol

The protocol of the UPM, AGMP and IGMP groups were based respectively on Braun,¹⁸ Riccio¹⁹ and El-Wishy²⁰ studies (Figure 1).

MP common protocol

The groups allocated to MP performed a protocol based on the El-Wishy¹⁹ study which is didactically divided into 4 steps, which are detailed below.

Step 1: Familiarization with MP

In the first session, participants were familiarized with MP by explaining the technique before performing it. They were also instructed to realize the imagination of the march from the visual perspective.

Step 2: Walking Guidance

In the first five sessions, the patients were presented with a slide containing audio images explaining the eight phases of the gait cycle (initial contact, load response, medium support, terminal support, pre-balance, initial balance, medium and terminal balance). The images presented were focused on the movements performed in each step of the gait and mounted using photos of an adult without PD. Next, the patients watched a video of an adult without PD walking at a comfortable speed along an average line of 10 meters from the anterior, posterior and lateral views.

Step 3: Identify Gait Changes

After watching the presentation with the explanation about the gait and the video of the adult without walking DP, the participant was presented the video of himself walking. This step happened only in the first session and was used for the patient to understand his own dysfunction and compare his gait with that of a person without PD, identifying with the therapist's help changes in gait kinematics.

Step 4: Gait Performance Assessment

In the 6th, 11th and 15th sessions, a new filming of the patient who was walking was performed, aiming to compare with the help of the therapist his performance of the first session with the others.

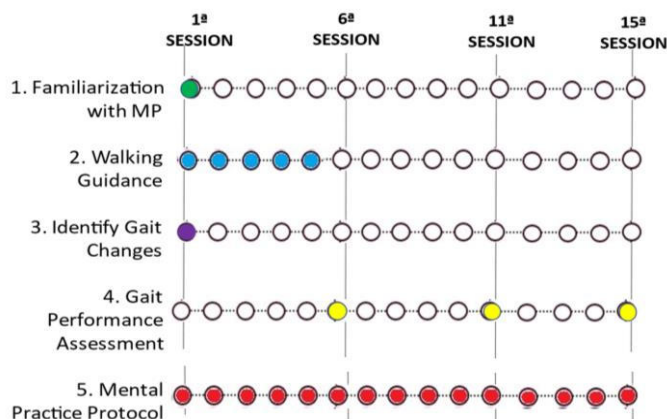


Figure 1. Mental practice intervention

Unguided Mental Practice (UPM) Group Protocol

During PM the patients were instructed to perform a 1-minute mental simulation of gait, trying to rescue the kinematic components learned in step 2 (common MP protocol) and correct possible changes in their own gait. This step occurred in all sessions of this group.

Imaged Guided Mental Practice (IGMP) Group Protocol

Immediately before the mental simulation, the patients watched a presentation of images focused on the movements performed by each joint during the eight gait steps and mounted using pictures of an adult without PD. After the explanation was over, they were instructed to perform the mental simulation of the gait for 1 minute, trying to rescue the kinematic components learned in step 2 (common MP protocol) and correct possible changes in their own gait. The images presented were the same as those used in the gait orientation step. This step occurred in all sessions of this group.

Audio Guided Mental Practice Group (AGMP) Protocol

Immediately before the mental simulation, the patients listened to an audio with verbal explanations about each step of the gait and after the explanation ended, they were instructed to perform the mental simulation of the gait for 1 minute, trying to rescue the kinematic components learned in step 2 (common MP protocol) and correct possible changes in your own gait. The audio presented was the same used in the gait orientation stage. This stage occurred in all sessions of this group.

Analysis of Results

Data were compiled through measures of central tendency and dispersion and expressed as mean and standard deviation. Normality tests are influenced by the sample size as to their efficiency. In small samples (between 4 and 30 units), there is type I error inflation, and the Shapiro-Wilk test is preferred.

Due to the small n nonparametric analyzes were used with comparison between the 4 experimental groups after the intervention through the Kruskal-Wallis post hoc test, Dunn test, considering $P < 0.05$. The principle of intention to treat was considered.^{21,22} The statistical package used was Statistica 13.0.

RESULTS

The sample consisted of 35 participants (24 men e 11 women), 7 in the CG, 9 in the IGMP, 9 in the AGMP and 10 UMP. The demographic and clinical characteristics of the participants are presented in Table 1. Regarding the variables TUG, Time, Speed, Cadence, there was no difference between the groups before the evaluation (Kruskal-Wallis test: $p=0.565$; $p=0.090$; $p=0.101$; $p=0.134$).

The IGMP group presented significant results for the parameters gait time (expressed in seconds, $p=0.027$) and gait speed (expressed in meters / second, $p=0.025$) when compared with the results obtained by the CG. The cadence evaluated by the 10MWT and the risk of falls assessed by the TUG had no major effect for the group (Table 2).

The UMP and AGMP groups did not present statistically significant results for WT10m and TUG when compared with CG.

Table 1. Patients' characteristics at baseline

Characteristics	Mental practice group without a guide n= 10 - Mean (SD)	Image guided mental practice n= 9 - Mean (SD)	Audio guided mental practice n= 9 - Mean (SD)	Group control n= 7 - Mean (SD)
Age (years)	64 (7)	63 (7)	64 (6)	63 (7)
Hohen and Yahr stage	1.7 (0.8)	2.0 (0.8)	1.6 (0.9)	2.0 (0.5)
Mini Mental Examination (score)	27.9 (1.5)	28.1 (2.4)	27.3 (1.5)	28.3 (1.4)
Beck's Depression Inventory (score)	10.0 (6)	8.9 (7.1)	9.5 (5.1)	9.9 (7.4)
KVIQ-10	3.8 (0.8)	3.6 (0.6)	3.9 (0,8)	NA
Gender	5 males, 5 females	8 males, 1 females	5 males, 4 females	6 males, 1 females
HY stage, n (HY1/HY2/HY3)	4 / 4 / 2	2 / 4 / 3	5 / 1 / 3	2 / 5 / 0

SD: standard deviation; KVIQ-10, Kinesthetic and Visual Imagery Questionnaire-10; NA: not rate

Table 2. Performance of patients before and after intervention

	Mental practice group without a guide n= 10 - Mean (SD)		Image guided mental practice n= 9 - Mean (SD)		Audio guided mental practice n= 9 - Mean (SD)		Group control n=7 - Mean (SD)		P-Value intergroup analysis
	Assessment	Revaluation	Assessment	Revaluation	Assessment	Revaluation	Assessment	Revaluation	
TUG (seconds)	10.86 (4.24)	9.30 (4.17)	10.24 (2.12)	9.40 (1.87)	10.47 (2.90)	9.75 (1.76)	8.96 (1.23)	8.43 (1.40)	0.308
Time (seconds)	5.40 (1.74)	4.65 (1,54)	4.57 (1.02)	4.19 (0,51)*	4.94 (1.35)	4.69 (1.01)	6.09 (1.33)	5.32 (0.54)*	0.027
Velocity (meter/seconds)	1.20 (0.31)	1.39 (0.34)	1.38 (0.31)	1.45 (0.18)*	1.31 (0.40)	1.34 (0.33)	1.02 (0.17)	1.13 (0.12)*	0.025
Cadence (step/seconds)	2.12 (0.32)	2.34 (0.33)	2.12 (0.44)	2.22 (0.23)	2.21 (0.32)	2.22 (0.23)	1.87 (0.16)	1.97 (0.06)	0.472

SD: standard deviation; p-Value: Kruskal-Wallis – post hoc Dunn Test (* $P<0.05$); TUG: Timed up and go test

DISCUSSION

Among the MP strategies used in this study, image-guided MP associated with Physiotherapy stood out among the others. There was an increase in velocity in the 10M WT in the experimental groups, with significant difference only for the IGMP group. Although without significant differences, the increase in cadence in the experimental groups may be a reflection of the reduced time to perform the test.

Reducing gait speed is known to be one of the dominant factors for the pathological gait of PD patients, leading them to difficulty walking and greater inactivity, leading to a vicious cycle, further decreasing functional capacity. of the person with PD.²³

The findings obtained in the IGMP group corroborate the study by El-Wishy²⁰ who also found superior results in relation to gait speed in the MP group associated with physiotherapy compared to physiotherapy alone.

The superiority of IGMP may be related to the fact that in humans, action observation activates neural circuits similar to those involved in action planning and execution. These neural circuits constitute the mirror neuron system that maps the sensory signals of the observation of the action on the same

neuronal substrate involved in the programming and motor execution of what was observed. In particular, the mirror neuron system is active during the observation of actions belonging to the observer's motor repertoire. The activation of this mirror neuron system becomes stronger when the observed actions represent the acts of everyday life performed by the observer, such as gait. In addition, action observation plays an important role in imitation and learning, as well as in the acquisition of new motor skills.²⁰

In contrast, auditory cues in the treatment of PD propose rhythmic auditory stimulation as activator of cortical, subcortical and spinal neuronal circuits involved in motor coordination that is deteriorated in these patients. The rhythmic characteristic of the auditory track would function as an alternative way to compensate for the internal disturbance in the temporal generation of movement.²⁴ However, the AGMP adopted in this study has instructional purpose, not being rhythmic commands. It is possible that these were also an influencing factor of the results linked to this group.

Moreover, a possible "ceiling effect" may have led to the maintenance of these variables in the AGMP considering that 55% of the subjects with stage 1 on the original Hoen and Yahr

scale were included in the group with very little room for improvement.

The study by Braun¹⁷ also evaluated temporal space parameters of gait in patients with mild PD, showing no statistically significant results with the use of UMP. Differences in the stage of PD present in the Braun¹⁷ sample may have influenced the results, since patients were included in both the early stages (possible 'ceiling effect') and the severe stages of PD. In addition, the cognitive demand required of the patient to perform MP may be high and the absence of a guide may hinder engagement in the technique.

In all groups (except the CG) patients migrated from the "medium risk of falls" extract to "low risk of falls", however no significant differences were observed between the strategies that allow us to designate the best one for this variable.

Maintaining the results on the risk of falls after intervention in the IGMP, AGMP and UMP group may be linked to the biomechanical strategies adopted during TUG performance such as the transfer from sitting to standing and from standing to sitting, and changes in direction during the gait (spin). These strategies were not objects of mental simulation in any of the PM groups, which may have influenced the results without regard to the risk of falls.²⁵

The weekly frequency, total sessions performed and motor imagination execution time (15 sessions twice a week of MP with 1 minute of motor imagination) by patients allocated to PM protocols may have been insufficient, considering that studies have shown that People with PD are able to learn new motor tasks, however, depending on the stage of the disease and the level of the tasks, these patients need more practice when compared to other individuals of the same age.²⁶ Gait motor imagination may be a complex activity to practice and that working with simpler functions and or movements may favor the motor imagination process.

Study limitations

Our findings should be interpreted with caution due to issues such as impossibility of guaranteeing that the patient actually performs MP is one of the most important limitations for using this strategy. The number, frequency of sessions, duration of motor imagination, small sample size, and inclusion of patients in the stage I of Parkinson's disease (ceiling effect) may have limited the findings.

Another point is that nonparametric tests such as Kruskal-Wallis have a higher possibility of type I error, making the effect measurements less generalizable. In addition, studies evaluating the effects of MP on spatiotemporal parameters of the risk of falls in PD patients remain scarce in the literature,⁵⁻²⁷ and present controversial results due to factors such as small samples, great heterogeneity among patients and diversity of intervention protocols.^{27,28} We motivate researchers to conduct randomized controlled clinical trials that can clarify the topic.

CONCLUSION

The use of image-guided mental practice associated with physical therapy seemed to contribute more to the increase in gait speed in the participants of this study than the other mental practice strategies.

ACKNOWLEDGMENT

This work was carried out with the support of the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - (CAPES) - Financing Code 001.

REFERENCES

1. Santos PCR, Morais LC, Simieli L, Ellen LS, Vitória R, Ferreira MDTOF, et al. Comparação do equilíbrio e da mobilidade funcional entre pacientes com doença de Parkinson ativos e inativos. *Rev Bras Ativ Fís Saúde*. 2016; 21(6):534-41. Doi: <https://doi.org/10.12820/rbafs.v.21n6p534-541>
2. Coriolano MGWS, Silva NRG, Fraga AS, Balbino JMS, Oliveira APS, Silva BRV, et al. Análise do risco de queda em pessoas com doença de Parkinson. *Fisioter Brasil*. 2016;17 (1):17-22. Doi: <https://doi.org/10.33233/fb.v17i1.17>
3. Silva DM, Coriolano MGWS, Macêdo JGF, Silva LP, Lins OG. Protocolos de prática mental utilizados na reabilitação motora de sujeitos com doença de Parkinson: revisão sistemática da literatura. *Acta Fisiatr*. 2016;23(3):155-60. Doi: <https://doi.org/10.5935/0104-7795.20160030>
4. Mulder T. Motor imagery and action observation: cognitive tools for rehabilitation. *J Neural Transm (Vienna)*. 2007;114(10):1265-78. Doi: <https://doi.org/10.1007/s00702-007-0763-z>
5. Silva TAM, Silva LP, Faccio PF, Silva KMC, Arruda ARV, Silva LN, et al. Análise dos parâmetros espaço-temporais da marcha em indivíduos com disfunção neurológica tratados com prática mental: uma revisão sistemática. *Acta Fisiatr*. 2018;25(2):86-93. Doi: <https://doi.org/10.11606/issn.2317-0190.v25i2a162567>
6. Brasil. Ministério da Saúde. Portaria n. 10, de 31 de outubro de 2017. Aprova o Protocolo Clínico e Diretrizes Terapêuticas da doença de Parkinson. *Diário Oficial da República Federativa do Brasil, Brasília (DF)*; 2017 Nov 9, Seção 1:60.
7. Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. *Neurology*. 1967;17(5):427-42. Doi: <https://doi.org/10.1212/wnl.17.5.427>
8. Vitiello APP, Ciríaco JGM, Takahashi DY, Nitrini R, Caramelli P. Avaliação cognitiva breve de pacientes atendidos em ambulatórios de neurologia geral. *Arq Neuro-Psiquiatr*. 2007;65(2A):299-303. Doi: <https://doi.org/10.1590/S0004-282X2007000200021>
9. Brucki SM, Nitrini R, Caramelli P, Bertolucci PH, Okamoto IH. Sugestões para o uso do mini-exame do estado mental no Brasil. *Arq Neuropsiquiatr*. 2003;61(3B):777-81. Doi: <https://doi.org/10.1590/s0004-282x2003000500014>
10. Martins NIM, Caldas PR, Cabral ED, Lins CCSA, Coriolano MGWS. Instrumentos de avaliação cognitiva utilizados nos últimos cinco anos em idosos brasileiros. *Ciênc Saúde Coletiva*. 2019;24(7):2513-30. Doi: <https://doi.org/10.1590/1413-81232018247.20862017>

11. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry*. 1961;4:561-71. Doi: <https://doi.org/10.1001/archpsyc.1961.01710120031004>
12. Malouin F, Richards CL, Jackson PL, Lafleur MF, Durand A, Doyon J. The Kinesthetic and Visual Imagery Questionnaire (KVIQ) for assessing motor imagery in persons with physical disabilities: a reliability and construct validity study. *J Neurol Phys Ther*. 2007;31(1):20-9. Doi: <https://doi.org/10.1097/01.npt.0000260567.24122.64>
13. Lang JT, Kassin TO, Devaney LL, Colon-Semenza C, Joseph MF. Test-Retest Reliability and Minimal Detectable Change for the 10-Meter Walk Test in Older Adults With Parkinson's disease. *J Geriatr Phys Ther*. 2016;39(4):165-70. Doi: <https://doi.org/10.1519/JPT.0000000000000068>
14. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc*. 1991;39(2):142-8. Doi: <https://doi.org/10.1111/j.1532-5415.1991.tb01616.x>
15. Souza CC, Valmorbid LA, Oliveira JP, Borsatto AC, Marta Lorenzini, Knorst MR, et al. Functional mobility in institutionalized and non-institutionalized elderly. *Rev Bras Geriatr Gerontol*. 2013;16(2):285-93. Doi: <https://doi.org/10.1590/S1809-98232013000200008>
16. Guimarães LHCT, Galdino DCA, Martins FLM, Vitorino DFM, Pereira KL, Carvalho EM. Comparison of the propensity of falls among elderly people who practice physical activity and sedentary elderly. *Rev Neurociências*. 2004;12(2):68-72.
17. Keus SHJ, Hendriks HJM, Bloem BR, Bredero-Cohen AB, Goede CJT, Van Haaren M, et al. Clinical practice guidelines for physical therapy in patients with Parkinson's disease. *Dutch J Physiotherapy*. 2004;114(3):1-92.
18. Braun S, Beurskens A, Kleynen M, Schols J, Wade D. Rehabilitation with mental practice has similar effects on mobility as rehabilitation with relaxation in people with Parkinson's disease: a multicentre randomised trial. *J Physiother*. 2011;57(1):27-34. Doi: [https://doi.org/10.1016/S1836-9553\(11\)70004-2](https://doi.org/10.1016/S1836-9553(11)70004-2)
19. Riccio I, Iolascon G, Barillari MR, Gimigliano R, Gimigliano F. Mental practice is effective in upper limb recovery after stroke: a randomized single-blind cross-over study. *Eur J Phys Rehabil Med*. 2010;46(1):19-25.
20. El-Wishy AA, Fayed ES. Effect of locomotor imagery training added to physical therapy program on gait performance in Parkinson patients: a randomized Controlled Study. *Egypt J Neurol Psychiat Neurosurg*. 2013;50(1):31-7.
21. Montori VM, Guyatt GH. Intention-to-treat principle. *CMAJ*. 2001;165(10):1339-41.
22. Gupta SK. Intention-to-treat concept: A review. *Perspect Clin Res*. 2011;2(3):109-12. Doi: <https://doi.org/10.4103/2229-3485.83221>
23. Monteiro EP, Wild LB, Martinez FG, Peyré-Tartaruga LA. Aspectos biomecânicos da locomoção de pessoas com doença de Parkinson: revisão narrativa. *Rev Bras Ciênc Esporte*. 2017;39(4):450-7. Doi: <https://doi.org/10.1016/j.rbce.2016.07.003>
24. Pires S, Festas MJ, Soares T, Amorim H, Santoalha J, Henriques A, et al. Pistas auditivas musicais na fisioterapia em grupo de doentes com Parkinson. *Arq Med*. 2014;28(6):162-6.
25. Faria CDCM, Teixeira-Salmela LF, Araújo PA, Polese JC, Nascimento LR, Nadeau S. TUG-ABS Português-Brasil: instrumento para avaliação clínica da mobilidade de hemiparéticos pós-AVC. *Rev Neurocienc*. 2015;23(3):357-67. Doi: <https://doi.org/10.34024/rnc.2015.v23.8005>
26. Pompeu JE, Arduini LA, Botelho AR, Fonseca MB, Pompeu SM, Torriani-Pasin C, et al. Feasibility, safety and outcomes of playing Kinect Adventures!™ for people with Parkinson's disease: a pilot study. *Physiotherapy*. 2014;100(2):162-8. Doi: <https://doi.org/10.1016/j.physio.2013.10.003>
27. Monteiro D, Silva LPD, Sá POD, Oliveira ALRD, Coriolano MDGWD, Lins OG. Prática mental após fisioterapia mantém mobilidade funcional de pessoas com doença de Parkinson. *Fisioter Pesq*. 2018;25(1):65-73. Doi: <https://doi.org/10.1590/1809-2950/17192425012018>
28. Silva LP, Duarte MPS, Souza CCB, Lins CCSA, Coriolano MGWS, Lins OG. Efeitos da prática mental associada à fisioterapia motora sobre a marcha e o risco de quedas na doença de Parkinson: estudo piloto. *Fisioter Pesq*. 2019;26(2):112-9. Doi: <https://doi.org/10.1590/1809-2950/17012926022019>
29. Abbott JH. The distinction between randomized clinical trials (RCTs) and preliminary feasibility and pilot studies: what they are and are not. *J Orthop Sports Phys Ther*. 2014;44(8):555-8. Doi: <https://doi.org/10.2519/jospt.2014.0110>