## ORIGINAL ARTICLE

## Effects of group physiotherapy on motor function in parkinsonism: quasi-experimental study

### *Efeitos de fisioterapia em grupo na função motora no parkinsonismo: estudo quasi-experimental*

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### Abstract

*Objective*: To study the effects of short-term group physiotherapy protocols on motor functional variables in subjects with Parkinsonism. *Methods*: A quasi-experimental, controlled, non-randomized, open label study, with consecutive arms for one group (n = 6) and parallel arms for the other (n = 9). One group (n = 9) observed by the researchers,

underwent group physical therapy once a week at a rehabilitation center for 5.5 to 7.5 months. Another group (n = 6) did not undergo physical therapy for a period of 5 months (control phase) and, consecutively, underwent group physical therapy twice a week for 12 weeks. Both groups were assessed with the Berg Balance Scale, Timed Up and Go Test, 5-Times Sit-to-Stand Test and 6-Minute Walk Test. *Results*: In all the variables analyzed, there were no statistically significant differences between the values measured in the assessments before and after the interventions (physical therapy once or twice a week) and the control phase. *Conclusion*: A short-term group physical therapy protocol, with a frequency of 1 or 2 times a week, may not be enough to improve motor control people with Parkinsonism.

**Keywords**: muscle strength; postural balance; physical fitness; physical therapy modalities; Parkinsonian disorders.

### Resumo

*Objetivo*: Verificar os efeitos de protocolos de fisioterapia em grupo, de curta duração, sobre variáveis funcionais motoras em sujeitos com parkinsonismo. *Métodos*: Estudo quasi-experimental, controlado, não randomizado, sem mascaramento, com braços consecutivos para um grupo (n = 6) e paralelo para outro (n = 9). Um grupo (n = 9), observado pelos pesquisadores, foi submetido a fisioterapia em grupo, uma vez por semana, em um centro de reabilitação, durante 6,4 meses. Outro grupo (n = 6) não fez fisioterapia por um período de 5 meses (fase controle) e, consecutivamente, foi submetido a fisioterapia em grupo duas vezes por semana durante 12 semanas. Ambos os grupos foram avaliados através da escala de equilíbrio de Berg, Teste Timed Up and Go, Teste de sentar e levantar 5 vezes e Teste de caminhada de 6 minutos. *Resultados*: Em todas as variáveis analisadas, não houve diferenças estatisticamente significativas entre os valores mensurados nas avaliações antes e depois das intervenções (fisioterapia 1 vez ou 2 vezes por semana) ou da fase controle. *Conclusão*: Um protocolo de fisioterapia em grupo de curto prazo, com frequência de 1 ou 2 vezes por semana, talvez não seja suficiente para promover ganhos motores em pessoas com parkinsonismo.

**Palavras-chave**: força muscular; equilíbrio postural; aptidão física; modalidades de fisioterapia; transtornos parkinsonianos.

## Introduction

Parkinson's disease (PD) is an idiopathic neurological disorder that affects the substantia nigra and is the second most common neurodegenerative disease, surpassed

only by Alzheimer's disease [1]. It is determined by neurobehavioral and/or musculoskeletal signs and symptoms: rigidity, tremor, bradykinesia, stooped posture, postural instability, changes in balance, gait, and muscle weakness [2]. Its classic diagnosis is based on the presence of these clinical criteria, which are also used to examine and classify the severity of PD, through the use of the Hoehn and Yahr Disability Stages Scale, which comprises five stages: the first one has unilateral involvement with minimal or no functional impairment and the last one presents severe motor impairment and total dependence on mobility and self-care activities [2,3].

Parkinsonism is a term used to describe a syndrome that has bradykinesia plus at least one of the following cardinal signs, as per United Kingdom Parkinson's Disease Society Brain Bank (UKPDSBB) criteria: tremor, rigidity, or postural instability. Primary parkinsonism corresponds to PD, which has idiopathic cause, whereas secondary parkinsonism (SP) has specific causes, usually other neurological diseases, or drug-induced injuries [4].

People with PD who participate in exercise programs show improvement in their motor functionality, with a better performance in functional mobility activities, muscle strength, endurance, coordination, flexibility, and balance when walking. This improve their quality-of-life perception, when they are compared to physically inactive patients [3]. Group physical therapy, performed with many patients at the same time under the supervision of a professional, is important as a neurorehabilitation program in the global management of PD, because it can improve balance, gait, and performance of activities of daily living [5].

This study verified the effects of short-term and group physical therapy protocols on motor functional variables in subjects with Parkinsonism (PD or SP).

## Methods

This is a quasi-experimental (observational with therapeutic intervention), controlled, non-randomized, unblinded study, with a consecutive arm for one group and parallel for another. The study followed the recommendations of STROBE – STrengthening the Reporting of OBservational studies in Epidemiology (https://www.strobe-statement.org). The study was conducted between October 2017 and December 2018.

This investigation followed the Brazilian guidelines and regulatory standards for research involving human beings and the Research Ethics Committee of State University of Goias approved it, under register 2.024.873/2017. Also, it was registered in the Brazilian Registry of Clinical Trials (REBEC) under the digital identifier (DI): RBR-

392cxdp. All participants signed the informed consent after they were informed about all aspects of the research.

*Inclusion criteria*

People who have PD or SP, diagnosed at least six months ago;
Be classified in stages 1, 2 or 3 of the Hoehn and Yahr scale (HY) [6,7] or, in the case of SP, with a motor status equivalent to these stages;
Be able to walk with total or modified independence;
Be aged between forty and seventy years;
Be under medical supervision for at least two months;
Have medical permission to practice exercises;
Make use of antiparkinsonian medication and have good adherence, with regular use.

*Exclusion criteria*

People who have undergone surgery for PD;
Have cardiovascular diseases that contraindicate physical exercise;
Have rheumatological, orthopedic and traumatological diseases that prevent joint mobility and contraindicate physical exercise;
Have arthrodesis in lower limbs and/or spine;
Have great limitation of joint movement in the lower and upper limbs and spine;
Present secondary balance disorders, such as severe vestibular disorders;
Have severe cognitive impairment, which prevents understanding of verbal instructions. The Mini-Mental State Examination (MMSE) should confirm this: with a score of less than 24 points for subjects with 8 years of schooling, less than 18 points for those with less than 8 years of schooling; and less than 14 points for illiterate people [8].

The intervention and control groups were organized as follows:

OG-E1wI (observed group, exposed to the once-a-week intervention): observed group, exposed to group physical therapy intervention once a week, each session lasting 40 minutes. The exercises performed included flexibility training, trunk and limb strengthening, motor coordination and gait. The researchers did not treat this group, they only just observed (assessed) it. Other physiotherapists treated this group at a public rehabilitation center in Goias. The researchers assessed every patient twice, with a difference of 5.5 to 7.5 months (minimum and maximum time), with a mean of 6.4 months

(193 days) between measurements. This, therefore, was an observational group of exposure to a protective factor (group motor training).

EG-C (experimental group, controlled phase): experimental group, control phase, monitored exclusively by the team of researchers at the State University of Goias (SUG). The treatment and evaluations were conducted by the researchers at the facilities of the Physiotherapy and Physical Education College at SUG, in Goiania, Brazil. This group was assessed three times over time. However, between the 1st and 2nd evaluation, the participants were not exposed to motor training, they remained sedentary. Therefore, the period between the 1st and 2nd assessment constitutes an independent control group for the OG-E1wI and a paired control group for the EG-2wI. This control period ranged from 3.7 to 6 months (minimum and maximum time), with an average of 5 months (150 days).

EG-2wI (experimental group, twice a week intervention phase): experimental group, intervention phase, monitored in the SUG, period that corresponds to the time phase between the second and third assessment. During this period, the participants did a group physiotherapy protocol, which lasted twelve weeks, with two sessions per week, lasting fifty to sixty minutes each, totaling twenty-four sessions. We made the second evaluation in the week before the first week of treatment, and we performed the third evaluation three months (ninety days) after the second evaluation, in the week after the last week of treatment. The protocol included self-stretching and isometric exercises with yoga and Pilates postures held for thirty seconds; trunk and limb strengthening exercises, performed in an active-free or active-resisted way, followed by circuit gait training with auditory cues.

There were two therapeutic arms:

Once-weekly treated arm: comparison of motor control evolution between OG-E1wI (treated group) and EG-C (untreated control group), independent samples;

Twice weekly treated arm: comparison between EG-2wI (treated group) and EG-C (untreated control group), paired (dependent) samples.

Two researchers (GSM and MCF) blindly performed assessments. The following assessment instruments were used:

Anamnesis;

Hoehn and Yahr Disability Stages Scale [6,7];

MMSE [8];

Timed Up and Go Test (TUG): measured time (TUG-t) and number of steps (TUG-s) [9,10];

Berg Balance Scale (BBS) [11];

Five times sit and stand test (5T-SST) [12,13];

Right hand grip strength (RHGS) and left hand grip strength (LHGS) measured with a Jamar® hydraulic dynamometer, according to the American Society of Hand Therapists protocol, with three measurements and considered the highest value in the dominant and non-dominant hand, with an interval of 1 minute between each measurement [14,15];

The distance covered in 6-minute walk test (6MWT), performed according to the recommendations of the American Thoracic Society [16].

In the statistical analysis, we used Excel® [17] to tabulate the data and prepare the descriptive statistics. Muscle strength (RHGS, LHGS and 5T-SST measurements), postural balance (BBS, TUG-t, TUG-s) and endurance (6MWT) were the dependent variables in the statistical analysis. The independent variables were the interventions. For inferential statistics, we used the Action Stat Pro version 3.6 application [18].

As there are 5 measures (assessments) for each dependent variable, there are 10 possible pairs of differences between measures to be established, although only 3 pairs are relevant to the research: difference between values of the 1st and 2nd assessment in the OG-E1wI, difference between 1st and 2nd assessment values in EG-C and difference between 2nd and 3rd assessment values in EG-2wI. All samples of the dependent variables showed non-normal distributions when analyzed with the Shapiro-Wil Test. For this reason, we used the Wilcoxon Test with an unusual p-value ($p = 0.005$), because it was necessary to divide the p-value by 10 to have a maximum alpha error of 5%, considering the 10 possible comparisons between 5 samples of collected data [19, 20].

The study had great difficulty in recruitment and adherence, with large sample losses, with a final sample of fifteen participants. There was no guarantee of statistical power of 80% for the statistical analyses.

## Results

We recruited 50 participants, who signed the consent form and were screened according to the inclusion and exclusion criteria. We began the study with 41 volunteers who met all inclusion criteria. There were 26 sample losses at follow-up, with a final sample of 15 participants. The figure 1 shows the flowchart of the intervention procedures performed in the study.
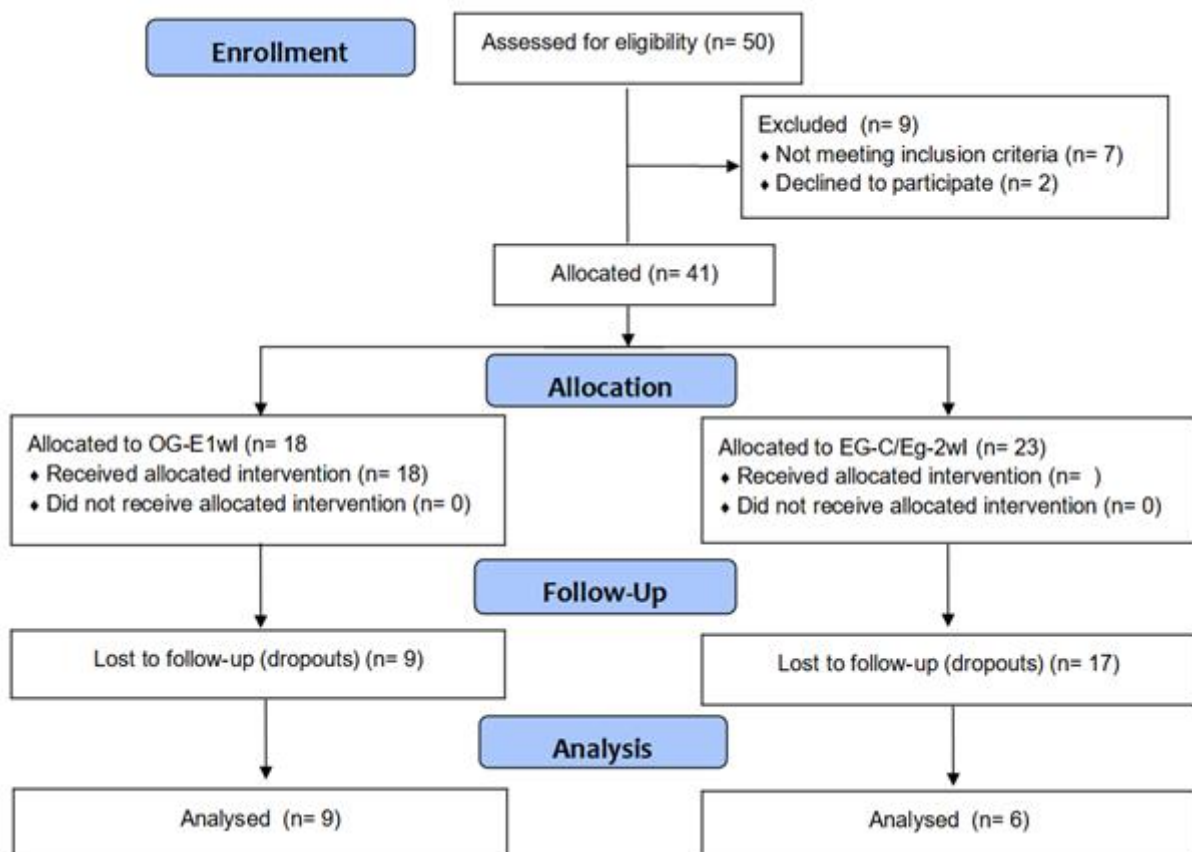


**Figure 1** – *Flowchart of intervention procedures*

In the OG-E1wl, seven participants were male and two were female. The age ranged from 44 years (minimum) to 77 years (maximum), with mean and standard deviation of de $\bar{x}(s)$ = 62.3 (7.6) years. The BMI (body mass index) ranged from 20.7 kg/m² (minimum) to 32.7 kg/m² (maximum), with mean and standard deviation of de $\bar{x}(s)$ = 25.7 (3.4) kg/m². Still, three participants had SP and 6 PD, four of them in stage I of the HY Scale, one participant in stage II and one participant in stage III.

In the EG-C/EG-2wl, 2 participants were male and four were female. The age ranged from 43 years (minimum) to 72 years (maximum), with mean and standard

deviation of $\bar{x}(s)$ = 62.8 (8.2) years. BMI ranged from 21.6 kg/m² (minimum) to 32.0 kg/m² (maximum), with mean and standard deviation of $\bar{x}(s)$ = 25.8 (2.4) kg/m². Also, five participants had PD, all in stage I of the HY Scale, and a participant had SP. This subject with SP and a participant with PD had choreoathetosis secondary to the use of antiparkinsonian drugs.

The results, obtained in the dependent variables in each sample group, are shown in table I. The results of the differences between the values obtained in the assessments conducted after and before the intervention in each therapeutic arm are presented in table II.

Table II shows that there were no statistically significant differences between the values obtained in the first and second assessments in the OG-E1wI and EG-C and between the second and third assessments in the EG-2wI.

**Table I** - *Distributions of values of the variables in the OG-E1wI and EG-C/EG-2wI*

| Variables | Assessment | OG-E1wI | | | | | EG-C/EG-2wI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | 1Q | M | 3Q | Max. | Min. | 1Q | M | 3Q | Max. |
| RHGS | 1st | 16.0 | 22.0 | 27.0 | 31.0 | 44.0 | 21.0 | 23.5 | 30.0 | 35.5 | 44.0 |
| | 2nd | * | * | * | * | * | 11.0 | 21.8 | 22.0 | 29.0 | 40.0 |
| | 3rd | | | | | | 15.0 | 22.5 | 25.0 | 30.5 | 44.0 |
| LHGS | 1st | 12.0 | 17.0 | 31.0 | 34.0 | 43.0 | 22.0 | 24.0 | 28.0 | 32.0 | 46.0 |
| | 2nd | * | * | * | * | * | 7.0 | 20.8 | 23.5 | 28.8 | 37.0 |
| | 3rd | | | | | | 14.0 | 22.8 | 26.0 | 31.5 | 36.0 |
| 5T-SST | 1st | 12.5 | 18.1 | 19.9 | 21.7 | 34.6 | 10.7 | 14.7 | 15.7 | 16.6 | 18.7 |
| | 2nd | 8.9 | 11.0 | 12.0 | 13.2 | 14.2 | 9.3 | 10.2 | 11.4 | 12.2 | 14.6 |
| | 3rd | | | | | | 11 | 11.9 | 13.7 | 15.8 | 16.8 |
| BBS | 1st | 44.0 | 46.0 | 51.0 | 53.0 | 55.0 | 45.0 | 51.0 | 54.0 | 54.8 | 56.0 |
| | 2nd | 48.0 | 51.0 | 53.0 | 53.5 | 54.0 | 30.0 | 49.5 | 50.0 | 54.3 | 55.0 |
| | 3rd | | | | | | 39.0 | 43.5 | 51.5 | 53.5 | 55.0 |
| TUG-t | 1st | 10.0 | 11.5 | 12.1 | 17.0 | 22.2 | 5.6 | 8.8 | 9.8 | 11.0 | 14.1 |
| | 2nd | 7.6 | 8.5 | 10.1 | 11.5 | 12.5 | 4.7 | 7.8 | 9.2 | 11.7 | 17.0 |
| | 3rd | | | | | | 7.5 | 8.5 | 9.4 | 11.0 | 12.3 |
| TUG-s | 1st | 10.0 | 12.0 | 14.0 | 16.0 | 19.0 | 8.0 | 8.8 | 11.0 | 12.5 | 15.0 |
| | 2nd | 12.0 | 12.0 | 13.0 | 15.0 | 17.0 | 8.0 | 12.0 | 13.5 | 15.5 | 17.0 |
| | 3rd | | | | | | 12.0 | 12.5 | 14.0 | 16.3 | 19.0 |
| 6MWT | 1st | 156.0 | 243.8 | 379.0 | 397.3 | 615.0 | 240.0 | 308.0 | 394.0 | 463.0 | 615.0 |
| | 2nd | 238.9 | 284.3 | 366.0 | 397.8 | 444.0 | 326.0 | 358.5 | 409.0 | 474.3 | 548.0 |
| | 3rd | | | | | | 220.0 | 308.0 | 355.5 | 416.5 | 437.0 |

*In the OG-E1wI, in the second assessment, the handgrip dynamometer was not available. So, we did not collect this information. 1Q = Value of the first quartile; 3Q = Third quartile value; 5T-SST = five times sit and stand test; 6MWT = 6-minute walk test; BBS = Berg Balance Scale; LHGS = Left handgrip strength; M = Median value; Max. = Maximum value; Min. = Minimum value; RHGS = Right handgrip strength; TUG-s = Timed Up and Go Test – steps (number of steps); TUG-t = Timed Up and Go Test – time (time result, in seconds)

**Table II** - *Distributions of differences in measurements of variables in OG-E1wl, EG-C and EG-2wl*

| Variable | Group | After-before difference distribution | | | | | |
|---|---|---|---|---|---|---|---|
| | | Min. | 1Q | M | 3Q | Max. | p-value† |
| RHGS | OG-E1wl | * | * | * | * | * | |
| | EG-C | -23.0 | -6.5 | -3.0 | 0.5 | 10.0 | 0.402 |
| | EG-2wl | 0.0 | 2.3 | 3.5 | 4.0 | 5.0 | 0.058 |
| LGHS | OG-E1wl | * | * | * | * | * | |
| | EG-C | -25.0 | -5.0 | -1.0 | 2.5 | 7.0 | 0.688 |
| | EG-2wl | -1.0 | 0.5 | 5.0 | 5.8 | 7.0 | 0.100 |
| 5T-SST | OG-E1wl | -17.5 | -8.9 | -8.0 | -5.3 | 1.7 | 0.031 |
| | EG-C | -7.7 | -6.0 | -4.0 | -1.7 | -0.4 | 0.008 |
| | EG-2wl | -0.6 | 0.4 | 1.9 | 3.4 | 4.8 | 0.106 |
| BBS | OG-E1wl | -4.0 | -1.5 | 1.0 | 1.0 | 7.0 | 1.000 |
| | EG-C | -15.0 | -3.5 | -2.0 | -0.5 | 1.0 | 0.104 |
| | EG-2wl | -9.0 | 0.3 | 2.5 | 4.8 | 9.0 | 0.498 |
| TUG-t | OG-E1wl | -4.7 | -3.4 | -3.1 | -2.3 | 1.3 | 0.031 |
| | EG-C | -2.8 | -1.0 | -0.4 | 0.4 | 4.4 | 0.640 |
| | EG-2wl | -5.7 | -1.9 | -1.4 | -0.7 | 0.9 | 0.094 |
| TUG-p | OG-E1wl | -2.0 | -0.5 | 0.0 | 0.5 | 2.0 | 1.000 |
| | EG-C | -4.0 | 0.0 | 3.5 | 6.0 | 7.0 | 0.140 |
| | EG-2wl | -5.0 | -0.8 | 1.0 | 2.0 | 2.0 | 0.784 |
| 6MWT | OG-E1wl | -171.0 | -134.0 | -31.1 | 0.4 | 12.0 | 0.250 |
| | EG-C | -157.0 | -40.0 | -33.0 | 52.0 | 86.0 | 1.000 |
| | EG-2wl | -134.0 | -48.3 | -27.5 | 0.8 | 15.0 | 0.156 |

*In the OG-E1wl, in the second assessment, the handgrip dynamometer was not available. So, we did not collect this information. Thus, it was not possible to present the distribution of after-before differences in this group. †Wilcoxon test p-value data. To be statistically significant, the after-before difference should have a p-value of 0.005 or less (as explained in the methods section). 1Q = Value of the first quartile; 3Q = Third quartile value; 5T-SST = five times sit and stand test; 6MWT = 6-minute walk test; BBS = Berg Balance Scale; LHGS = Left handgrip strength; M = Median value; Max. = Maximum value; Min. = Minimum value; RHGS = Right handgrip strength; TUG-s = Timed Up and Go Test – steps (number of steps); TUG-t = Timed Up and Go Test – time (time result, in seconds)

## Discussion

The aim of this study was to determine the effects of a physical therapy protocol on the motor function of individuals with PD classified as Hoehn Yahr stages 1, 2 and 3 or with SP. The results suggest that exposure to a group kinesiotherapy intervention, either twice a week or once a week, does not have important effects on muscle strength, postural balance, and endurance capacity of the participants. We emphasize that the reduced sample did not allow adequate statistical power to detect differences.

However, we also hypothesized that the intervention may not have had clinically important therapeutic effects on the patients' motor control because the intervention was infrequent, with weekly frequencies of once a week (in the OG-E1wl) and twice a week (in the EG-2wl).

Only 2 studies (Tollár *et al.* [21,22], with treatment of 5 sessions per week for 3 weeks; Kurt *et al.* [23], with 5 sessions per week for 5 weeks) found that group physical therapy has effects on the dynamic postural balance, as measured by the TUG test, with

statistically significant differences between measurements after and before treatment or in the mean difference between the group physical therapy group and the control group without motor intervention. Another 5 clinical trials (Hashimoto *et al.* [24], with treatment of 1 weekly session for 12 weeks; Hubble *et al.* [25,26], with 1 weekly session for 12 weeks; Claesson *et al.* [27], with 2 sessions per week for 8 weeks; King *et al.* [28], with 3 sessions per week for 4 weeks) found no statistically significant difference between group physical therapy group and no motor treatment group or even between values measured after and before group physical therapy treatment. In the studies that demonstrated the effects of group physical therapy on dynamic balance, the weekly frequency of consultations was 5 times a week. In the other studies, in which physical therapy had no effect, the frequencies ranged from 1 to 3 sessions per week.

All studies that measured static postural balance found effects of group physical therapy. In the measurement through the BBS or the MiniBESTest (Mini Balance Evaluation Systems Test), 8 studies (Conradsson *et al.* [29], treatment with 3 weekly sessions for 10 weeks; Sparrow *et al.* [30], 3 weekly sessions for 3 months ; Landers *et al.* [31], with 3 weekly sessions for 8 weeks; Claesson *et al.* [27]; Hashimoto *et al.* [24]; Hubble *et al.* [25,26]; King *et al.* [28] ; Kurt *et al.* [23]) reported statistically significant differences between measurements after and before treatment or in the mean difference between active and control groups. As for the measurement through stabilometry, the study by Tollár *et al.* [21,22] found that group physical therapy was superior to control, with a statistically significant reduction in body sway measurements. Also, the Kurt *et al.* [23] trial revealed a statistically significant reduction in body sway measurements, comparing values measured after and before treatment.

The study by Lander *et al.* [31] demonstrated that group physical therapy promotes a statistically significant increase in the values of the 6MWT and in the muscular strength of the lower limbs measured through the sit-and-stand test for 30 seconds (a variation of the 5T-SST).

The study by Sparrow *et al.* [30] reports that group physical therapy, compared to no-treatment control, reduced the rate of falls per month, with a reduction of 36.8% (rate ratio= 0.632 [0.524, 0.763] 95% CI).

Previously reported clinical studies used a variety of motor training strategies, such as: 45 minutes of focused somatosensory balance training without visual or audible cues [27]; the HiBalance program, a 60-minute regimen of highly challenging balance training that incorporates two-task and PD-specific balance components [29]; 60 minutes of high intensity and agility exercises using sensorimotor and visual stimuli, training mobility and postural balance [21,22]; ABC program (Agility Boot Camp) with 60 minutes of activities that target basic postural systems in a "training camp" model to target

biomechanical restrictions, kinesthesia, stability limits, anticipatory postural adjustments, bradykinesia and coordination during gait, with 6 stations (Tai chi, Boxing, Lunges, Kayaking, Agility Course and Pilates) with activities that progress in difficulty [28]; 90-minute program of strengthening exercises, range of motion, reactive and anticipatory balance activities, sensory input alteration and gait training [30]; training camp with 90 minutes of high-intensity exercises (aerobic, resistance, balance and flexibility) [31]; 60-minute warm-up training program, stretching, joint mobilization and gait exercises [23]; 90 minutes of trunk mobility and endurance training [25,26]; 60 minutes of flexibility, balance, postural transfer (from sitting to standing and vice versa, repeatedly) and gait training [24].

The present study has limitations: the small number of participants due to large sample losses, which may have caused lower statistical power of the investigation. In order to obtain more reliable conclusions about the effects of group physical therapy on the motor control of people with parkinsonism, it is necessary to conduct randomized clinical trials with a larger sample and longer follow-up time to verify the effects on motor control variables of group physical therapy delivered one or two times a week.

## Conclusion

The data from the present study suggest that a group physical therapy protocol with a frequency of 1 or 2 times a week, training flexibility, strength (training with light to moderate load) and gait, may not be enough to improve motor control in people with Parkinson Disease in stages 1-3 or with mild to moderate SP.

The scientific literature data suggest that group physical therapy with a greater weekly frequency, of at least three weekly sessions, has effects of improvement in motor control, especially protocols with five weekly sessions and longer session duration.

**Authors' contributions**
*Research conception and design*: Barbosa AM, Gervasio FM; *Data collection*: Barbosa AM, Fortaleza NO, Castro JA, Bastos RARB (intervention in the experimental group); Menezes GS, Faria MC (physiotherapist's assessments); *Data analysis and interpretation*: Barbosa AM, Fortaleza NO, Castro JA, Gervasio FM, Menezes GS, Faria MC, Neves PRS, Bastos RARB; *Statistical analysis*: Barbosa AM; Writing of the manuscript: Barbosa AM, Fortaleza NO, Neves PRS; *Critical review of the manuscript for important intellectual content*: Barbosa AM, Fortaleza NO, Castro JA, Bastos RARB, Menezes GS, Faria MC, Gervasio FM, Neves PRS

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