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ORIGINAL ARTICLE

# Home-based exercises with minimal oversight in Parkinson's Disease motor function: A systematic review and meta-analysis

*Exercícios domiciliares com mínima assistência na função motora da Doença de Parkinson: uma revisão sistemática com meta-análise*

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## Abstract

**Aims:** this study aimed to present the latest available evidence on the effects of home-based exercises with minimal oversight (HBEMO) on motor function and quality of life of Parkinson's Disease (PD) subjects.

**Methods:** in this systematic review MEDLINE (PubMed), LILACS, PEDro, EMBASE, Cochrane and Google Scholar were searched for randomized clinical trials investigating the effects of HBEMO on PD subjects.

**Results:** four studies were included in the meta-analysis. HBEMO was almost as beneficial as conventional therapies in lowering motor impairment through Unified Parkinson's Disease Rating Scale-III (UPDRS-III) analysis (Mean difference = -1.70 [95%CI = -4.39 to 0.99]; $I^2$ = 88%; $p < 0,01$) and improving quality of life through The Parkinson's Disease Questionnaire (PDQ-39) (Mean difference = 0.39 [95%CI = -3.41 to 4.19]; $I^2$ = 93%; $p < 0,01$).

**Conclusions:** minimally assisted home-based exercises are almost as effective as the usual care to improve motor function and quality of life of Parkinson's Disease subjects.

**Keywords:** Parkinson disease, exercise therapy, quality of life, neurological rehabilitation, physical therapy modalities.

## Resumo

**Objetivos:** este estudo teve como objetivo apresentar as últimas evidências disponíveis sobre os efeitos de exercícios domiciliares com mínima supervisão na função motora e na qualidade de vida de indivíduos com doença de Parkinson.

**Métodos:** nesta revisão sistemática foram pesquisados ensaios clínicos randomizados investigando os efeitos de exercícios domiciliares em indivíduos com doença de Parkinson nas bases de dados MEDLINE (PubMed), LILACS, PEDro, EMBASE, Cochrane e Google Scholar.

**Resultados:** quatro estudos foram incluídos na meta-análise. O exercício domiciliar com supervisão mínima foi quase tão benéfico quanto as terapias convencionais na redução do comprometimento motor por meio da análise da Unified Parkinson's Disease Rating Scale-III (UPDRS-III) (diferença média = -1.70 [95%IC = -4.39 a 0.99]; $I^2$ = 88%; $p < 0,01$) e melhoria da qualidade de vida por meio do Parkinson's Disease Questionnaire (PDQ-39) (diferença média = 0.39 [95%IC = -3.41 a 4.19]; $I^2$ = 93%; $p < 0,01$).

**Conclusões:** a fisioterapia domiciliar com supervisão mínima é quase tão eficaz quanto as terapias convencionais para melhorar a função motora e a qualidade de vida da doença de Parkinson.

**Palavras-chave:** doença de Parkinson, terapia por exercício, qualidade de vida, reabilitação neurológica, modalidades de fisioterapia.



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## Introduction

Parkinson's disease (PD) is a growing health problem, with an incidence that is expected to double from 6.2 million cases worldwide in 2015 to 12.9 million cases by 2040. Based on this data, PD was pointed out as an "imminent noninfectious pandemic" (1). In times of coronavirus pandemic, the question is, how to handle these two pandemics concomitantly and prevent patients from falling into the harm of physical inactivity?

In order to manage such disabling symptoms of PD, alongside the well-established pharmacological and surgical interventions, it is important to insert in the routine of PD subject's neurorehabilitation (2-4). Considering the progressive characteristic of the disease, to stay physically active is essential to improve motor and non-motor symptoms and to ensure good mobility, functionality, and independence in carrying out activities of daily living (5, 6). Moreover, physical exercise is related to corticostriatal plasticity and increased dopamine receptor expression (7).

However, there are many factors that may limit engagement in exercise, such as health care costs, difficulty of locomotion, living in remote locations (8), lack of time to exercise, low expectation regarding symptoms improvement, and fear of falling (9). With the new reality imposed by the covid-19 pandemic and the need for social distance, the adherence to physical activity and rehabilitation became even more challenging and the demand for therapeutic options such as telerehabilitation and home-based physical therapy has increased.

Home-based physical therapy are guided exercises made by the patient at home, with minimal therapist oversight (10). The therapist delivers information about the exercises and explanations on how to execute the movements correctly (11), but there is no need of its physical presence in all sections. Previous studies reported interventions of home-based physical therapy with PD subjects using different approaches, such as monitoring by telephone (12, 13), tablets (13), an initial, weekly, or mensal face-to-face meetings for explanations (10, 14, 15) and telerehabilitation (16). In our study, we called this intervention modality as Home-Based Exercises with Minimal Oversight (HBEMO).

However, there is controversy as to the real benefits of unsupervised exercise for Parkinson's disease. While some argue that unsupervised home exercise programs are the least effective way of providing exercise for people with PD (10, 14), others enable the modality of face-to-face non-supervision by a therapist as beneficial for issues related to motor status (balance, gait, activities of daily living, disease severity and quality of life) (12, 13, 16).

The methodologies described in these studies are very heterogeneous and to the best of our knowledge, the only meta-analysis in this context encompasses all modalities of telehealth (17), and the only systematic review regarding home-based physical therapy in PD investigated balance (18) and gait speed. Thus, the objective of this study was to present the latest available evidence on the effects of HBEMO on motor function and quality of life of PD subjects.

## Methods

### *Design and search strategy*

This systematic review was reported according to the PRISMA Statement [19] and the Cochrane Collaboration [20]. Its protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO: CRD42020200832) and can be fully assessed online at https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=200832.

Specifically, the following PICO question was formulated: "Amongst Parkinson's disease subjects, to what extent do structure home-based interventions, in comparison to non-training controls, active controls or to another exercise intervention, impact motor function (UPDRS-III) and quality of life (PDQ-39)?".

Literature searches were conducted using electronic databases MEDLINE (accessed by PubMed), LILACS, Physiotherapy Evidence Database (PEDro), EMBASE, Cochrane Central Register of Controlled Trials (Cochrane CENTRAL), and Google Scholar. The searches were carried out

in September 2020, with studies published until this data. The search strategy used the terms "parkinson disease" and "home-based physical therapy" or "home-based exercise". Words related to outcomes of interest were not included to enhance the sensitivity of our search. Search terms were adjusted to fit the requirements of each electronic database. The search strategy used is shown in Supplementary Appendix 1.

### *Eligibility criteria, intervention, and participants*

Our study included only randomized clinical trials with at least one intervention group of home-based exercises and one comparator group, which assessed the effects of interventions on motor function through UPDRS-III and quality of life through PDQ-39. The comparisons were made between home-based exercise and placebo, control, or other treatment. Editorial comments, reviews, and meta-analyses were excluded. The languages were restricted to English, Portuguese, and Spanish. Randomized clinical trials included adult subjects, men, and women, of any race or ethnic background, with Parkinson's disease diagnosis.

### *Outcome measures*

The primary outcome was the motor function assessed by the UPDRS-III and the secondary outcome was quality of life assessed by PDQ-39.

### *Study selection and data extraction*

Two independent reviewers assessed the titles and abstracts of all articles identified by the search strategy. Potentially eligible but uncertain studies were retrieved for full-text evaluation. The same reviewers independently assessed the full text to perform selection according to pre-specified eligibility criteria. Data extraction was done by two reviewers independently using a standardized form and included the methodological design, number of subjects, comparison groups, intervention protocol, and results of outcomes of interest. Extracted outcomes were related to motor function and quality of life. Disagreements between authors during the selection of articles were evaluated by a third reviewer when it was not possible to reach a consensus.

### *Assessment of risk of bias*

The assessment of methodological quality was made descriptively, according to the method proposed by the Cochrane Collaboration, considering the following characteristics of the studies: random sequence generation, concealed allocation, blinding of participants and investigators (professional who administered the training), blinding of outcome assessors, incomplete outcome data, selective reporting, and other bias. The judgment was categorized as low, high, or unclear risk of bias (16).

### *Data analysis*

The meta-analysis was performed using the random-effect model. Effect size was calculated using the difference between the mean and standard deviation before and after the intervention, comparing the intervention group and control group. Statistical heterogeneity was assessed using the Cochrane's Q test and the inconsistency test ($I^2$), which values above 25% and 50% were considered indicative of moderate and high heterogeneity, respectively. An alpha value ≤ 0.05 and a confidence interval of 95% (95% CI) were considered statistically significant. All meta-analyses with forest plots were performed with R language in the RStudio software. The risk of bias graphic was generated in Review Manager version 5.3.5.

## Results

### *Flow of studies*

In the search strategy, 6.061 papers were found, but 418 were duplicates. After reviewing the titles and abstracts, 10 papers were selected for full-text evaluation. From those, 4 were excluded because of its methods and 2 articles were not randomized clinical trials. Finally, four papers were included in the systematic review and four in the meta-analysis (**Figure 1**).

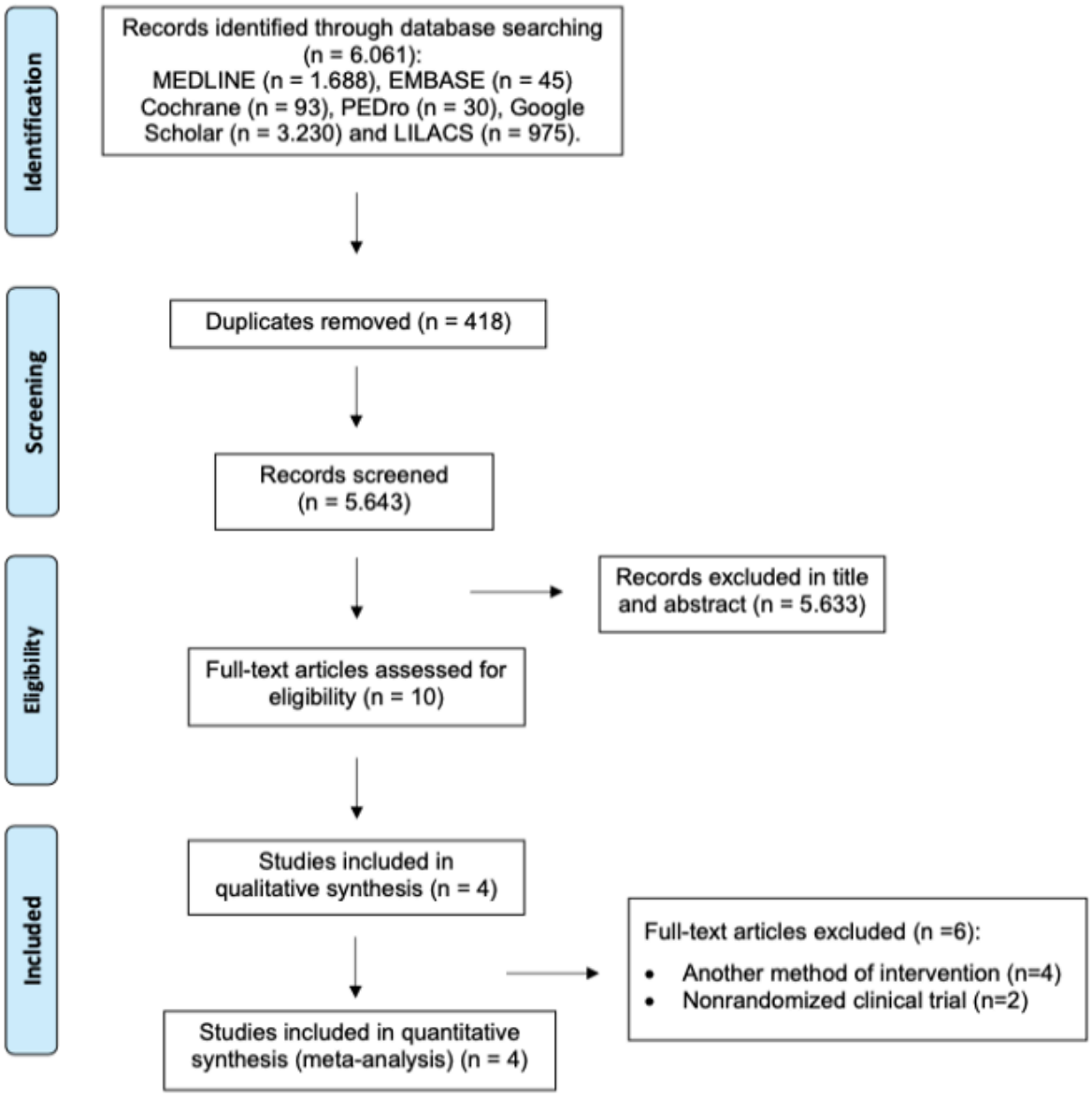


**Figure 1.** PRISMA flow diagram of study selection.

*Descriptions of studies*

Four studies included in this systematic review and meta-analysis evaluated motor function through the UPDRS-III and quality of life through PDQ-39 (10, 12-14). **Table 1** shows the characteristics of the included studies. There was great variability between the training protocols regarding the intervention time, at 4 weeks (10), 12 weeks (12, 16), four months (10) and six months (13).

**TABLE 1 –** Characteristics of the studies included in the systematic review.

| Author, Year | Subjects / H&Y | Training Protocol | Comparator | Measured outcomes | Features |
|---|---|---|---|---|---|
| Schenkman et al., 2012 (14) | 121 PD / 1-3<br>41 intervention<br>80 control | Home-based exercise program, 45-60 minutes a day, 3 times a week for 4 months. Supervision was with a clinic-based group session once a month for 16 months. | Flexibility/balance/ function (FBF) exercise and aerobic exercise (AE). Both with supervision 3 times a week for 4 months, with tapered supervision for 1 month, and then once monthly to 16 months. | Continuous-Scale Physical Functional Performance Test; Functional Reach Test; UPDRS II-III; PDQ-39. | Functional benefits at 4 months in the FBF group and improved walking economy (up to 16 months) in the AE group. |
| King et al., 2015 (10) | 58 PD / 2-4<br>17 intervention<br>41 control | Home-based exercise program, 60 minutes a day, 3 times a week for 4 weeks with an initial presential meeting for instructions. | Individual physical therapy and group class intervention during the same period and same frequency. | 7-item PPT; UPDRS II-III, PDQ-39, LARS, SES, GDS, Mini-BESTest, FOG, stride velocity, arm velocity, trunk velocity, stride time, turn duration, TUG, TUG-D. | Individual exercise showed major improvements in functional and balance measures, group class showed major improvements in gait, and home exercise improved the least across all outcomes. |
| Gondim et al., 2017 (12) | 28 PD / 1-3<br>14 intervention<br>14 control | Home-based exercises 60 minutes a day, 3 times a week for 12 weeks. Weekly monitoring by telephone. | Usual Care. Lectures of 40 minutes twice a month with physiotherapy instructions. Subjects and caregivers were instructed to do therapeutic exercises at home three times a week (on intercalated days), with a maximum duration of 60 minutes. | UPDRS II-III, PDQ-39. | Individualized counseling and weekly telephone monitoring in a self-supervised home-based therapeutic exercise program had positive effects on the analyzed outcomes in people in the early stages of PD. |
| Kolk et al., 2019 (13) | 28 PD / 1-2<br>14 intervention<br>14 control | Home-based remotely supervised aerobic exercise, 30-45 minutes a day, 3 times a week for 6 months. Supervision through one home visit and one calling. | Remotely supervised stretching, flexibility and relaxation exercises during the same period and same frequency. Supervision through one home visit and one calling. | MDS-UPDRS III-IV, Number of falls, 6MWT, TUG, Mini-BesTEST, Pegboard Test, Finger Tapping Test, PDQ-39. | Aerobic exercise can be done at home by subjects with mild PD and it attenuates off-stage motor signs. |

6MWT, Six Minute Walk Test; FOG, Freezing of Gait Questionnaire; GDS, Geriatric Depression Scale; H&Y, Hoehn and Yahr; LARS**,** Lille Apathy Rating Scale; MDS – UPDRS (II-III-IV), Movement Disorders Society - Unified Parkinson's Disease Rating Scale (activity daily living – motor exam – medication); PD, Parkinson Disease; PDQ-39, Parkinson Disease Questionnaire; PPT, Physical Performance Test; SES, Self-Efficacy Scale; TUG, Timed Up and Go Test, TUG-D, Timed Up and Go Test with Dual Task.

The number of protocol days during the week and the intervention time was also varied between three times a day for 30-45 minutes (13), for one hour (10, 12, 14). Comparison groups were individual physical therapy in a group class intervention (10), stretching (13), supervised flexibility, balance and function exercise, supervised aerobic exercise (14), and usual care (12, 15).

### *Risk of bias*

In the random sequence generation and allocation concealment, all studies presented a low risk of bias (selection bias); all studies also presented adequate blinding of participants and personnel (low risk of performance bias). Regarding blinding of outcome assessment, one study presented low risk of bias (12) and three studies presented unclear risk of bias (10, 13, 14) (detection bias). For incomplete outcome data, one study presented a low risk of bias (12) and three studies presented a high risk of bias (10, 13, 14) (attrition bias). All studies presented a low risk of bias for selective reporting (reporting bias) and other bias (**Figure 2**).

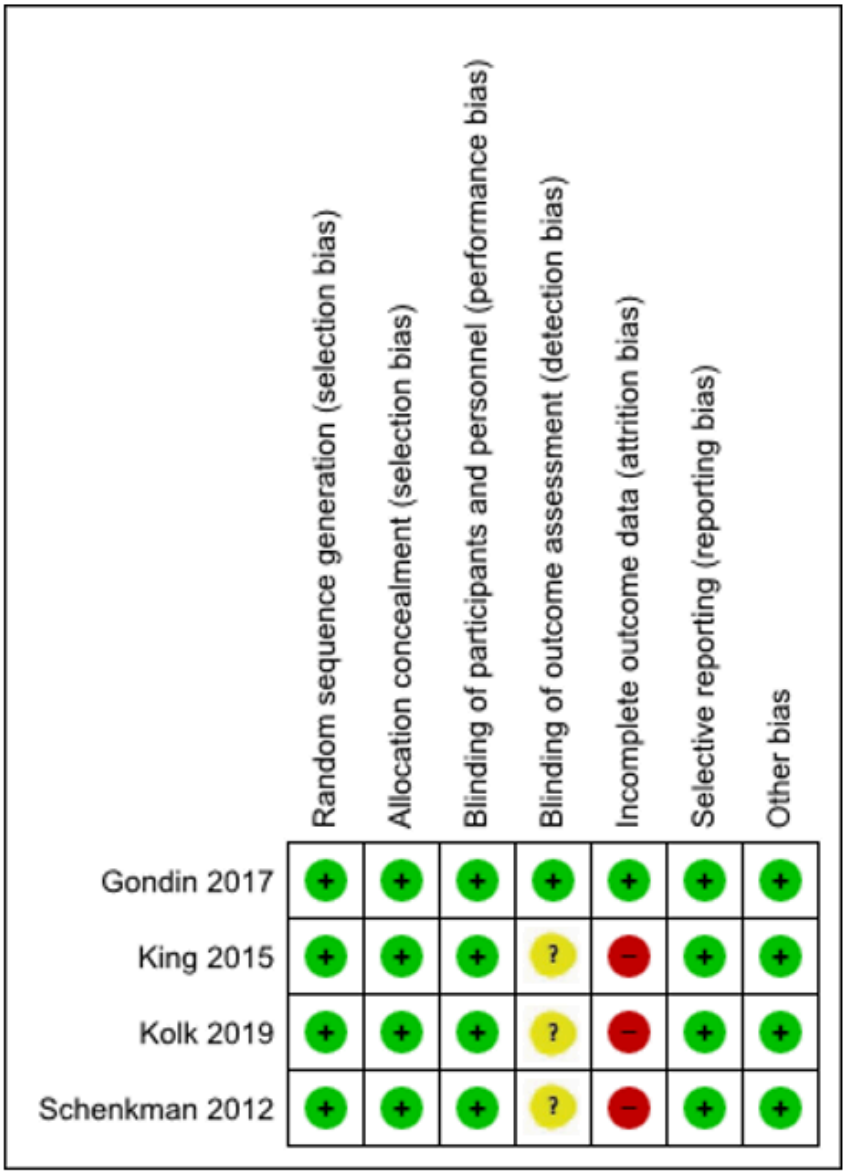


**Figure 2.** Risk of bias.

### *Effects of interventions for Motor function*

The meta-analysis for motor function included four studies (10, 12-14) assessing UPDRS-III in 261 subjects. The intervention was as effective as individual physical therapy (10), active stretching (13), flexibility, balance and function exercise, supervised aerobic exercise (14) or usual care (12), in the improvement of motor aspects, showing high heterogeneity (Mean difference = -1.70 [95%CI = -4.39 to 0.99]; $I^2$ = 88%; p < 0,01) (**Figure 3**).

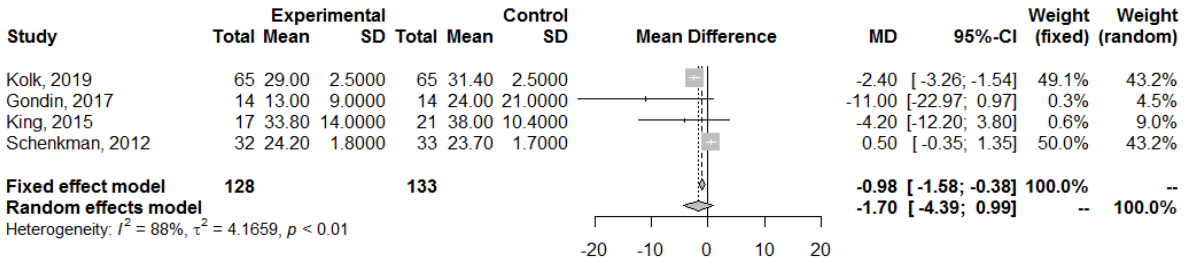


**Figure 3.** Forest-plot of pooled results for motor function (UPDRS-III).

### *Effects of intervention for Quality of life*

The meta-analysis for quality of life included four studies (10, 12-14) assessing PDQ-39 in 261 subjects. The intervention was as effective as individual physical therapy (10), active stretching (13), flexibility, balance and function exercise, aerobic exercise (14) or usual care (12), in the improvement of quality of life, presenting high heterogeneity (Mean Difference = 0.39 [95%CI = -3.41 to 4.19]; $I^2$ = 93%; p < 0,01) (**Figure 4**).

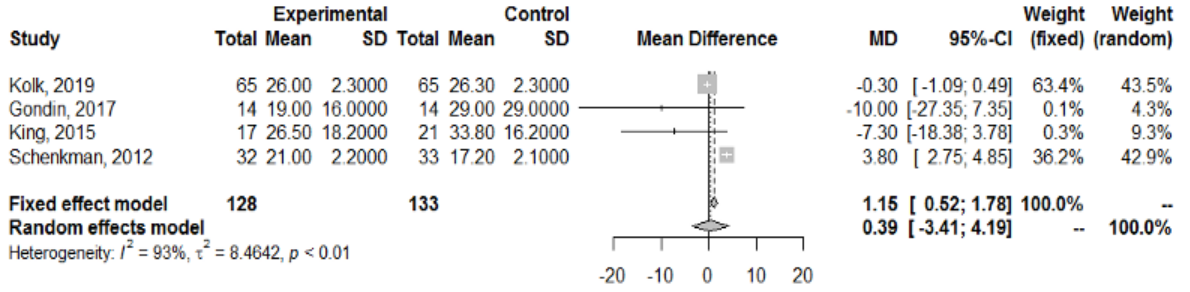


**Figure 4.** Forest-plot of pooled results for quality of life (PDQ-39).

## Discussion

Our aim was to present the latest available evidence on the effects of HBEMO on motor function and quality of life of PD subjects. We found only four studies for the meta-analysis, which highlights the need for studies in the area. Our review suggests that HBEMO is almost as effective as the usual treatment, which is positive in pandemic times, where not only subjects with PD, but the general population should maintain social distance and remain physically active even at home.

The form of supervision varies widely between the studies. The supervision modalities range from weekly by telephone (12), one face-to-face initial section for instructions (10), a single monthly group exercise session (14), one weekly presential session (15), online meeting with video class (16), and one home visit and one calling (13).

The heterogeneity of the studies was also substantial in relation to interventions and periodicities, but in general, they demonstrated that therapies performed at home with minimal monitoring can bring similar results to those found in conventional therapies. Seidler, Duncan (16) found that the tango done at home with telerehabilitation had similar benefits to tango in person for balance and severity of motor impairment. Gondim, Asano (12) investigated an individualized guidance and telephone monitoring in a self-supervised home-based physical therapy, demonstrating benefits on activities of daily living, motor impairment and quality of life. van der Kolk, de Vries (13) strengthens the use of aerobic cycling exercise done at home by subjects with mild PD to minimize off-stage motor signs.

Shanahan, Morris (15) investigated the effects of an Irish set dancing intervention. Participants were randomized into dance group and usual care control group. The dance group participated in a 1.5 hour per week of Irish set dance class and a plus of home dance classes for 20 minutes, three times per week. The usual care group maintained its drug treatment and daily activities. Although the comparison group did not have an in-person only intervention, they concluded that the intervention with additional hours at home is feasible, enjoyable and may improve quality of life.

Schenkman, Hall (14) compared three exercise approaches: a flexibility/balance/function exercise, a supervised aerobic exercise, and a home-based exercise. In general, home-based was the one that least improved function, but for some outcomes there was no difference between groups. Similarly, King, Wilhelm (10) also compared three exercise approaches: a home exercise program, an individual physical therapy, and a group class intervention. The home-based exercise improved the least across the investigated outcomes. But even with less favorable results for home-based exercises with minimal oversight, King, Wilhelm (10), Schenkman, Hall (14) were part of our meta-analysis, which nevertheless showed similar results for motor function and quality of life when compared with conventional therapies.

With a heterogeneity similar to that found in our study, Appleby, Gill (19) conducted a systematic review on the effects of telerehabilitation for stroke subjects. They pointed out that telerehabilitation may have a positive impact on several outcomes, but there is a lack of evidence and consensus about interventions parameters and measurement of outcomes. Perrochon, Borel (20) conducted a similar systematic review of exercise-based games for the rehabilitation of neurological patients at home, including PD subjects. They also found that the effectiveness of this intervention was equivalent to conventional physical therapy.

It is important to discuss the positive and negative aspects of interventions at home. At home, the patient can be easily distracted by noises, a poor illumination can disturb some exercise performance, the patient often will depend on the support of a family member (21, 22), and if a technologic tool is used to supervise the exercise there are some technological issues such as problems in internet connection and discouragement when confronted with technologic devices (20). However, eliminating the need of a clinic space there is a reduction in costs and time with traffic, parking, and long hours in waiting rooms (23, 24). Besides that, the exercise done at home contributes to a more relaxed and comfortable environment (23).

In the context of the COVID-19 pandemic, Dorsey, Okun (25) has summarized the advantages of telehealth as the 5 C's: accessible care, increased convenience, enhanced comfort, greater confidentiality to patients and families, and now reduced risk of contagion. COVID-19 imposed social distance, the closing of some facilities and clinics and the transition of many professionals from the face-to-face interventions to telehealth (25).

A previous study investigating the effectiveness of telehealth in PD subjects found that telehealth is a viable option for improving motor impairment, but did not lead to a significant difference in mental status, activities of daily living, motor complications, quality of life, depression, cognition and balance when compared to usual care (17).

In this review telehealth was defined as a quick communication between healthcare providers and patients through communication technologies (26). Our study, on the other hand, investigated studies involving home-based physical therapy / exercise, necessarily including intervention with minimally supervised exercise and physical activity.

Lai, Bond (27) pointed out that an internet-supervised training at home seems to guarantee a greater adherence to an exercise program when compared to a self-managed home-exercise training. Adherence to exercise for long periods it is a big challenge for PD subjects but offering monitoring and turning exercise more engaging and accessible may improve adherence (13). Besides that, a minimum level of supervision for exercising at home is recommended to ensure a correct performance and favorable results.

Our study has certain limitations. The number of randomized clinical trials for the quantitative analysis was small and half of them had small sample sizes. Besides that, the interventions were too heterogeneous for comparison purposes. But to the best of our knowledge this is the first meta-analysis to investigate the efficacy of HBE-MO on motor function and quality of life of PD subjects. Considering the low level of evidence and the high heterogeneity, our results must be interpreted carefully, and we encourage further research to be carried out.

In conclusion, despite the heterogeneity of the studies, home-based exercises with minimal oversight seems to be almost as effective as conventional therapies to improve motor function and quality of life of Parkinson's Disease subjects.

## Notes

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This study did not receive financial support from external sources.

## Conflicts of interest disclosure

The authors declare no competing interests relevant to the content of this study.

## Authors' contributions

All the authors declare to have made substantial contributions to the conception, or design, or acquisition, or analysis, or interpretation of data; and drafting the work or revising it critically for important intellectual content; and to approve the version to be published.

## Availability of data and responsibility for the results

All the authors declare to have had full access to the available data and they assume full responsibility for the integrity of these results.

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