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The Effects of a 10-Week Home-Based Exercise Programme in Individuals with Parkinson's Disease during the COVID-19 Pandemic: A Pilot Study

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Featured Application: This study explored a home-based exercise program during the COVID-19 pandemic that produced positive effects on gait characteristics and clinical outcomes in individuals with Parkinson's disease.

Abstract: Current restrictions on clinical visits as a consequence of the COVID-19 pandemic has increased the need for home-based exercise regimes to facilitate useful, long term patterns of behaviour in individuals with Parkinson's disease (PD). This study aimed to evaluate the effectiveness of a 10-week home-based exercise program designed to target improvements in axial rigidity and gait. The Movement Disorders Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS), motor scale and rigidity items, Functional axial rotation–physical (FAR-p), functional reach test (FRT), and time up and go (TUG) test were recorded. In addition, the 10-metre walk test, the fall efficacy scale international (FES-I) and the global rating of change score (GROC) were also recorded. Eighteen individuals were divided randomly into two groups: a home-based exercise group (n = 10) and a traditional physiotherapy control group (n = 8). Participants in the 10-week home-based exercise group showed significant improvements ($p < 0.05$) in the MDS-UPDRS rigidity item, FAR-p, step length, gait velocity, FRT and FES-I when compared with the control group. This study supports the use of home-based exercises in individuals with PD. These preliminary results also support the hypothesis that targeting axial deficits may be an effective approach for improving gait and reducing falls.

Keywords: Parkinson's disease; exercise; home-based; axial rigidity; gait

1. Introduction

Parkinson's disease (PD) is a neurodegenerative disorder that significantly affects functional mobility and quality of life [1], and gait disorders, in particular, are some of the most common disabling presentations [2]. Studies have revealed that individuals with PD have a gait pattern characterised by freezing, festination, hesitance, and shuffling steps, which are associated with axial deficits and balance, which can lead to an increased risk of falling [2–6]. In addition, previous research has shown that individuals with PD demonstrate a disrupted coordination of the axial segments, which is needed to maintain the stability and postural responses during walking [2–4]. The main treatment for PD

consists of medication, deep brain surgery, and exercise rehabilitation aimed at alleviating motor and non-motor symptoms [1,7]. There is strong evidence to support the beneficial effects of exercise programmes with regard to disease progression and wellbeing in individuals with PD [1,5,7,8]. In addition, it has been suggested that a regime of moderate to vigorous exercise for 30 min or more a week has a positive impact on global motor and non-motor symptoms in PD [9]. Various exercise programmes, either supervised within a clinic or unsupervised in a home-based situation, have been designed to specifically target problems of individuals with PD [8,10,11]. However, a number of studies have shown that supervised exercise programmes only have short-term beneficial effects and exercise has limited impact on gait and balance over time [11,12]. A more long-term solution could be the development of a 100% personalized home-based programme, but there are few studies to date addressing their effectiveness [11–15]. By using exercises, gait and balance training and rotational training, the aim is to improve axial rigidity, posture, gait, balance, and turning. However, there is a lack of evidence on the effectiveness of specific home-based exercise programmes to alleviate axial rigidity in individuals with PD. The purpose of this study was to investigate the effects of a home-based exercise programme on balance, gait characteristics and axial rigidity and related locomotion in individuals with PD. We hypothesized that a targeted home-based exercise programme could be used to reduce axial rigidity, and to improve balance and gait in individuals with PD. This work is doubly important at the current time due to restrictions on clinical visits as a consequence of the COVID-19 pandemic, and home-based exercise regimes may be able to facilitate the development of a useful, long term pattern of exercise behaviour for individuals with PD.

2. Materials and Methods

2.1. Study Design and Participants

This study was conducted in the Faculty of Physical Therapy at Mahidol University. Participants were referred from the Movement Disorders clinic where a neurologist diagnosed the stage of PD and evaluated medication status at the local public hospital. Participants were matched by severity and randomly assigned to either the home-based exercise group (HOME) or the control group (CON) by using a computer-generated programme. The inclusion criteria were patients clinically diagnosed with 2 to 3 stage idiopathic PD on the modified Hoehn and Yahr (H&Y) scale, patients who had been on a stable PD medication regimen for 8 weeks before the study (no signs of wearing-off phenomenon), patients who were able to walk independently without any assistive device, and/or patients who were able to follow commands and instructions. Exclusion criteria for the study included patients who had a clinical diagnosis of dementia (using the Mini-Mental State Examination with a score $\geq 24/30$), patients with any clinically significant medical condition, such as cardiopulmonary disease and musculoskeletal problems that could affect gait assessments, and any patients with visual problems that could not be corrected with lenses or glasses. All individuals with PD were evaluated by the same experienced physiotherapist.

2.2. Exercise Programme

After a baseline evaluation, individuals with PD and their relatives in the HOME group were given a series of home-based exercises in a booklet and watched the video instructions recommended by Schenkman et al. (1998) on how to do the exercises [3,16]. In addition, they also received a booklet with step-by-step instructions and illustrations of the exercise programme (Supplementary File S1). The exercise training sessions consisted of a 45 min segmental rotation exercise in supine, side lying, sitting and standing positions to increase flexibility and mobility, a 5 min throwing task to improve balance and challenge stability, and a 10 min gait training exercise. These elements of the exercise programme were approved by PD experts (FK, SK, PS and AA). Each session took about 60 min and was completed every day for 10 weeks. The control group (CON) had traditional physiotherapy (PT) treatment for a one-hour session twice a week for 10 weeks, facilitated by an experienced neurological physiotherapist, which included stretching exercises, strengthening

exercises, and gait and balance training. Participants in both groups had to strictly adhere to their usual medications. Every week the researcher phoned the participants or their relatives within the home group to address any concerns. The experimental protocol and testing procedure were explained prior to the patients completing an informed consent form, in keeping with the Declaration of Helsinki. The local Ethics Committee on Human Experimentation approved the study (MU-CIRB 2020/048.1902), and the clinical trial was registered on clinicaltrials.gov (NCT04810897).

2.3. Procedure

To ensure the consistency of outcomes, the assessments were conducted in parallel at the same time points for both groups at baseline and after the 10-week period by a blinded assessor. Gait characteristics from force plate data and clinical outcomes were investigated for both groups, see Figure 1 for the CONSORT flow diagram. All participants in both groups were asked to take their PD medication no longer than 1 to 1.5 h prior to testing at both baseline and post-assessment. In addition, all participants were tested at the same time of day for each assessment.

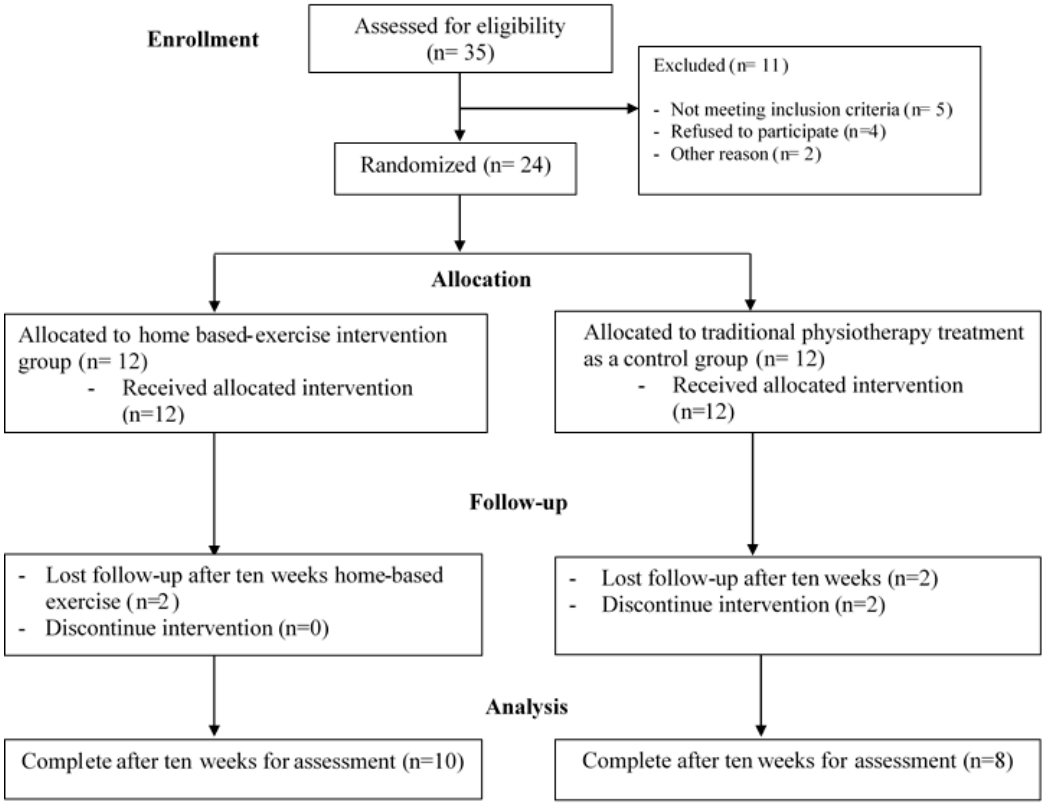

Figure 1. CONSORT diagram for this study.

2.3.1. Primary Outcome Measures

The motor score of the Movement Disorders Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS) has been shown to be an easy-to-use instrument in clinical practice with an average time requirement for administration between 15 to 20 min. The total motor MDS-UPDRS score ranges from 0 to 132, with the higher score corresponding to a more severe disability. In addition, the MDS-UPDRS rigidity item was also reported separately from the motor section.

Functional axial rotation–physical (FAR-p) is a measure of axial mobility combined with spinal motion. Permission to use the FAR-p instructions and equipment was granted for use in this study [16] and was assessed with the participant seated and the pelvis stabilized by Velcro straps. A hoop with numbers and letters in 5° increments was suspended

at eye level by two tripods. The participants wore a head piece from the cervical range of motion instrument (CROM; Performance Attainment Associates, Roseville, MN). Each participant was instructed to turn as far as possible first to the right, then to the left, and to report the furthest symbol (numbers and letters) that could be seen. The symbol with which the pointer aligned was recorded. A practice trial and two test trials were conducted, and the data were used to calculate an average.

Gait characteristics were assessed using a 3 m force distribution platform (The Zebris FDM-System-Gait Analysis; Zebris Medical GmbH, Isny, Germany) with a sampling frequency of 100 Hz, which was synchronized with a video camera (SC-1 SYNCCam; Zebris Medical GmbH) (Figure 2). The participants stood at the edge of the platform and were asked to walk barefoot at a comfortable speed to the other end of the platform, this was repeated for a total of 3 trials. The averaged data were recorded for foot rotation (deg), step width (cm), step length (cm), step time (s), cadence (steps/min) and gait velocity (km/s).

Figure 2. The participant was instructed to walk barefoot at a comfortable speed.

2.3.2. Secondary Outcome Measures

The functional reach test (FRT) is a clinical measure of balance control and is used to measure spinal flexibility. A yard stick was positioned on the wall at the height of the acromion. The test was performed 3 times and data were averaged.

The time up and go test (TUG) is used to assess balance and mobility in the elderly and individuals with PD. The average of 3 attempts of the time required to rise from a chair, walk 3 m, return to the chair, and sit down again was collected, with the faster times indicating better balance and mobility.

Gait speed was evaluated using the 10 m walk test (10MWT) divided by time. This was repeated for both normal and fast speeds. Participants were instructed to walk at a comfortable pace to a 10 m distance marked on the floor. They started this test 2 m before the start line and completed the test approximately 2 m after the finish line to allow time to get up to speed and stop, respectively. Time was recorded from the time when participants crossed the start line to the time when they crossed the finish line. Participants repeated the exercise at two speeds, normal and fast. The exercises were repeated 4 times in total and the data were used to calculate an average for each speed.

The fall efficacy scale international (FES-I) is a self-reported fear of falling questionnaire. Participants were asked to rate the 16 items of the questionnaire on a four-point Likert scale depending on their concerns (from 0: not at all concerned to 4: very concerned) about the possibility of falling when performing 16 activities, with higher scores indicating a greater fear of falling.

The global rating of change (GROC) is a self-assessment of perceived change, which uses an 11-point Likert scale. A GROC score of zero was considered as unchanged, and GROC scores of +1, +2, +3, +4 and +5 represent an increase in perceived improvement. In contrast, GROC scores of −1, −2, −3, −4, and −5 indicate the degree of perceived deterioration,10 with a threshold of +2 or −2 considered as clinically important changes.

2.4. Statistical Analysis

Statistical analyses were performed using IBM SPSS statistics version 24 (IBM Corporation, Armonk, NY) and the significance level was set to $p < 0.05$. The data distribution was tested using the Shapiro–Wilk test and the data were found to be not normally distributed, therefore, nonparametric analyses were used. The Wilcoxon signed-rank test was used to compare the variables between baseline and 10 weeks within the two groups, and the Mann–Whitney U test was used to compare the variables between the HOME and CON groups.

3. Results

Twenty-four individuals with PD were recruited; however, only 18 of these completed the study. Out of the 18, 10 participants were allocated to the HOME group and 8 participants to the CON group. Of the six individuals who withdrew from the study, two were from the HOME group due to the restrictions associated with the COVID-19 pandemic, and four were from the CON group due to lack of time and family issues. Demographic data are shown in Table 1. There were no significant differences between the two groups at baseline with regard to demographics, or duration and severity of disease, assessed using the Modified H&Y scales (Table 1).

Table 1. Comparison of demographic of individuals with PD between the home-based exercise group (HOME) (n = 10) and the control group (CON) (n = 8).

Demographic	HOME Group (n = 10)	CON Group (n = 8)
Age (years (SD))	68.60 ± 6.67	68.88 ± 6.73
Body mass index (kg/m^2 (SD)))	23.66 ± 3.36	23.83 ± 4.23
Men/women n (%)	6 (60)/4 (40)	4 (50)/4 (50)
Parkinson's disease duration (years)	5.08	4.80
Modified Hoehn and Yahr scale	2.6	2.58
Medical comorbidities (n, %)		
Hypertension	4 (40%)	4 (50%)
Diabetes mellitus	3 (30%)	2 (25%)
Dyslipidemia	2 (20%)	1 (12.5%)
Heart disease	1 (10%)	1 (12.5%)
Mini-Mental State Examination	29.4 ± 5.02	29.25 ± 4.72
Education (n (%))		
High School	6 (80)	5 (62.5)
>High school	1 (10)	2 (25)
<High school	3 (30)	1 (12.5)
Taking L-DOPA as a single medication (n)	6	5
Taking L-DOPA with other medications (n)	4	3

Abbreviation: HOME indicates the home-based exercise group, and CON indicates the control group.

In addition, individuals with PD in the HOME group did not significantly differ from the CON group with regard to the amount of PD medication, and no statistical differences were seen between the groups before the exercise treatment when assessed using the MDS-UPDRS motor part and MDS-UPDRS rigidity items, FAR-p, gait characteristics, FRT, TUG, 10MWT and FES-I (Table 2).

Table 2. Baseline comparison of primary and secondary outcomes between groups. Values are mean ± standard deviation.

Outcome Measure	HOME Group (n = 10)	CON Group (n = 8)	p-Value
Primary outcomes			
MDS-UPDRS motor part (score)	21.83 ± 7.99	23.17 ± 9.87	0.094
MDS-UPDRS rigidity item (score)	2.10 ± 0.67	2.20 ± 0.55	0.109
Functional axial rotation–physical (cm)	101.02 ± 73.50	98.37 ± 47.90	0.024
Gait characteristics			
Foot rotation (deg.)	10.16 ± 8.77	10.65 ± 7.10	0.657
Step width (cm)	12.10 ± 6.00	11.63 ± 3.96	0.720
Step length (cm)	22.64 ± 12.39	21.28 ± 13.04	0.091
Step time (s)	1.05 ± 0.52	1.30 ± 0.86	0.060
Cadence (steps/min)	73.80 ± 8.63	72.25 ± 7.76	0.083
Gait velocity (km/s)	1.04 ± 0.79	0.94 ± 0.43	0.054
Secondary outcomes			
Functional Reach Test (cm)	31.09 ± 10.99	29.45 ± 8.13	0.074
Time Up and Go (s)	17.86 ± 11.07	16.27 ± 8.16	0.067
Gait speed (m/s)			
Normal speed	0.80 ± 0.33	0.78 ± 0.17	0.723
Fast speed	1.03 ± 0.29	1.04 ± 0.33	0.556
Fall Efficacy Scale-International (score)	20.11 ± 7.18	19.83 ± 6.97	0.689

Abbreviation: MDS-UPDRS indicates Movement Disorders Society-Unified Parkinson's Disease Rating Scale, HOME indicates the home-based exercise group, and CON indicates the control group.

The comparison of primary and secondary outcomes between the groups revealed significant improvements in the HOME group in those outcomes when compared to the CON group after the 10-week exercise regime, specifically in the MDS-UPDRS rigidity item (U = 15.0, $p < 0.017$), step length (U = 21.0, $p < 0.033$), gait velocity from the 3 m force distribution platform (U = 14.5, $p < 0.023$) and FES-I (U = 23.0, $p < 0.047$), as shown in Table 3. For the within group comparisons, the Wilcoxon signed-rank tests showed no statistical differences in any outcomes in the control group between the baseline and 10-week time point. However, a significant improvement was seen between the baseline and after 10 weeks within the HOME group for FAR-p ($Z = -2.67$, $p < 0.008$), step length ($Z = -1.17$, $p < 0.041$), FRT ($Z = -0.95$, $p < 0.012$), fast speed of 10-MWT ($Z = -1.72$, $p < 0.008$) and FES-I ($Z = -2.527$, $p < 0.012$) (Table 4).

Table 3. Comparison of primary and secondary outcomes and the changes between groups. Values are mean ± standard deviation.

Outcome Measure	HOME Group (n = 10)	Change Score from Baseline	CON Group (n = 8)	Change Score from Baseline	p-Value
Primary outcomes					
MDS-UPDRS motor part (score)	20.67 ± 8.25	1.16 ± 0.82	23.50 ± 10.62	−0.33 ± 0.23	0.237
MDS-UPDRS rigidity item (score)	1.67 ± 0.71	0.43 ± 0.30	2.67 ± 0.52	−0.47 ± 0.33	0.017 *
Functional axial rotation-physical (cm)	120.79 ± 71.22	−19.77 ± 13.98	78.84 ± 47.86	19.53 ± 13.81	0.059
Gait characteristics					
Foot rotation (deg)	12.86 ± 6.53	−2.7 ± 1.91	11.53 ± 8.16	−0.88 ± 0.62	0.534
Step width (cm)	13.20 ± 6.11	−1.1 ± 0.78	13.13 ± 4.29	−1.5 ± 1.06	0.964
Step length (cm)	40.13 ± 17.76	−17.49 ± 12.37	22.04 ± 12.10	−0.76 ± 0.54	0.033 *
Step time (s)	1.46 ± 1.03	−0.41 ± 0.29	1.29 ± 0.65	0.01 ± 0.01	0.059
Cadence (steps/min)	87.20 ± 6.96	−13.4 ± 9.48	83.38 ± 16.15	−11.13 ± 7.87	0.350
Gait velocity (km/s)	1.88 ± 0.60	−0.84 ± 0.59	0.90 ± 0.55	0.04 ± 0.03	0.023 *
Secondary outcomes					
Functional Reach Test (cm)	33.62 ± 8.78	−2.53 ± 1.79	30.33 ± 9.51	−0.88 ± 0.62	0.723
Time Up and Go (s)	16.49 ± 6.58	1.37 ± 0.97	15.27 ± 5.82	1 ± 0.71	0.960
Gait speed (m/s)					
Normal speed	0.99 ± 0.35	−0.19 ± 0.13	0.79 ± 0.18	−0.01 ± 0.01	0.239
Fast speed	1.13 ± 0.39	−0.1 ± 0.07	0.99 ± 0.17	0.05 ± 0.04	0.637
Fall Efficacy Scale-International (score)	18.56 ± 7.57	1.55 ± 1.10	22.17 ± 7.52	−2.34 ± 1.65	0.047 *
The global rating of change (score)	1 ± 1.58		0.5 ± 1.76		0.361

Abbreviation: MDS-UPDRS: Movement Disorders Society-Unified Parkinson's Disease Rating Scale, HOME indicates the home-based exercise group, and CON indicates the control group. * denotes statistical significance.

Table 4. Comparison of primary and secondary outcomes between the baseline and post-exercise assessments within the home-based exercise groups (HOME). The p-values refer to the differences within group in two assessments: the baseline and after the 10 week exercise regime. Values are mean ± standard deviation.

Outcome Measure	Baseline	After 10-Week Exercise Regime	p-Value
Primary outcomes			
MDS-UPDRS motor part (score)	21.83 ± 7.99	20.67 ± 8.25	0.196
MDS-UPDRS rigidity item (score)	2.10 ± 0.67	1.67 ± 0.71	0.057
Functional axial rotation-physical (cm)	101.02 ± 73.50	120.79 ± 71.22	0.008 *
Gait characteristics			
Foot rotation (deg.)	10.16 ± 8.77	12.89 ± 6.53	0.053
Step width (cm)	12.10 ± 6.00	13.20 ± 6.11	0.380
Step length (cm)	22.64 ± 12.39	40.13 ± 17.76	0.041 *
Step time (sec)	1.05 ± 0.52	1.26 ± 1.03	0.445
Cadence (steps/min)	73.80 ± 8.63	87.20 ± 6.96	0.446
Gait velocity (km/s)	1.04 ± 0.79	1.88 ± 0.60	0.085
Secondary outcomes			
Functional Reach Test (cm)	31.09 ± 10.99	33.62 ± 8.78	0.012 *
Time Up and Go (s)	17.86 ± 11.07	16.49 ± 6.58	0.263
Gait speed (m/s)			
Normal speed	0.80 ± 0.33	0.99 ± 0.35	0.058
Fast speed	1.03 ± 0.29	1.13 ± 0.39	0.008 *
Fall Efficacy Scale-International (score)	20.11 ± 7.18	18.56 ± 7.57	0.012 *
The global rating of change (score)	-	1 ± 1.58	-

Abbreviation: MDS-UPDRS: Movement Disorders Society-Unified Parkinson's Disease Rating Scale. * denotes statistical significance.

Booklet and Telephone Follow up Reporting during the 10 Week Exercise Period

During the 10-week period, four participants in the HOME group did not perform the exercises from the booklet and video during the first week (as noted from the diary records). The researcher had to call and remind those participants and their caregivers to carry out the exercise regime every day. In addition, it was discovered that six participants completed the exercises regularly and, in addition, carried out other activities, such as going to the shopping centre, doing housework, and watering plants. This may have improved their scores in the assessments. These activities may have also increased their motivation to complete the exercises and enabled them to do more. Another two participants frequently spent long periods in the sitting and lying-down position but still completed the exercises three times a week.

4. Discussion

PD is a degenerative disease with progression increasing impairment, limitations to functional activities and restrictions, despite medical management using appropriate drugs or modern neurosurgical techniques [1,7,17]. In this context, physiotherapy interventions—in particular, exercise—have been proposed as methods to limit the progressive nature of the disease and maintain function [1,7]. Recently, the use of home-based programmes for individuals with PD has become a popular area for exploration [13–15,18,19]. Our study investigated the effect of a home-based exercise programme with the view to try and reduce axial rigidity and improve gait characteristics in individuals with PD at stage 2 or 3 on the modified Hoenh and Yahr scale. The results showed that individuals with PD in the HOME group had a statistically significant improvement in primary outcomes, including the MDS-UPDRS rigidity item, FAR-p, step length, and gait velocity, and also in secondary outcomes including FRT and FES-I. In addition, the GROC scores showed a clinically important change in the HOME group. There were no statistically significant differences recorded in the CON group, although some outcome measures did show improvements—step width, step length, cadence, which was accompanied by a clinically important change in the grouped GROC scores.

Previous studies have had similar outcomes to our study in the exploration of home-based exercise programmes. Santos et al. (2012) [20] conducted a home-based exercise programme with 31 individuals with PD. Changes in UPDRS were measured and they found an improvement in the UPDRS motor scores in individuals with PD who were younger than 60 years of age. However, the researcher did not specify in which components of the UPDRS motor scale they had observed the improvements. Another comparative study between home-based and therapist-supervised exercise was carried out in 2017 by Atterbury and Welman using gait and balance outcomes [21]. They demonstrated that individuals with PD in the home-based group showed an improvement in some aspects of gait. In addition, Nocera et al. (2009) investigated a home-based programme in 10 individuals with PD in 2 to 3 on the modified H&Y scale over a 10-week period and observed improvements in postural control [13]. These findings were consistent with those in our study and suggest that exercise is an essential intervention adjunct to medication treatment in cases of PD.

In contrast there is some evidence which indicates that exercise supervised by a therapist is more effective than a home-based exercise programme. A study by Dereli in 2010 [12] found that the exercise programme under physiotherapist supervision was more effective in improving activities of daily living, motor, mental and emotional functions and general health quality of life in individuals with PD compared with those on a self-supervised home programme. Similarly, a study by Morris et al. (2017) [15] investigated the rate of falls and quality of life between a home programme for individuals with PD which consisted of strength and movement strategy training and falls education over 6 weeks and a control group. The results indicated that fall rates were not substantially different between the groups. Finally, Flynn et al. [11] showed that home-based exercise improves balance-related activities and gait speed in individuals with PD. However, the COVID-19

pandemic has severely disrupted outpatient physiotherapy services in Thailand. As a result of social distancing, immobilization, outpatient restrictions in clinic attendance and the risk of contracting COVID-19 in this vulnerable group, home-based exercise may be the only option for individuals with PD in preventing the deterioration of the motor and non-motor symptoms in this population.

Taken together, in the case of the home-based exercise programme in this study, we have carried out a scoping review and modified an axial mobility programme designed by Schenkman et al. (1998) [16] and investigated gait characteristics. To add weight to these methods, the contents of the exercise programme were used and derived, which were then approved by PD experts. As described, the exercises were performed over 10 weeks at home, which led to improved axial rigidity and better performance with regard to balance, gait characteristics and a reduction in the fear of falls. However, this should be considered in context with the individuals with PD in the HOME group who may have been encouraged by the researcher contacting them every week, helping them overcome any challenges with the axial rotational training, leading to improved gait performance. Therefore, the individuals in the HOME group may have been more motivated and educated, and there may be links between the level of education and motivation to complete the exercises, leading to greater improvements and a greater level of support from their caregivers. In addition, the two groups did have different dosages of intervention, the home group being prescribed a 60 min exercise training session, which was completed every day for 10 weeks, with the control group having one-to-one physiotherapy treatment for one hour twice a week for 10 weeks; however, these interventions were based on what is pragmatically possible within the clinic and home-based situations.

In our study, not all individuals with PD showed significant improvements after the exercise regime. This may be due to a lack of understanding and the exercises not being performed correctly as the overall data show improvement in both primary and secondary outcomes, and the exploration of responders and non-responders requires further consideration in future studies. Moreover, these findings indicate that future research with a similar design with a larger sample size is necessary to confirm or reject these results.

5. Conclusions

The present study found that individuals with PD showed significant improvements in the MDS-UPDRS rigidity item, FAR-p, step length, gait velocity, FRT and FES-I after following a home-based exercise programme. This highlights that exercise targeting axial rigidity provided in the home situation can be beneficial and may be an effective approach for improving gait and reducing falls in individuals with PD, especially when access to clinical centres is challenging.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/app11104518/s1, Supplementary File S1: The booklet details of exercise programme.

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