



E-ISSN: 2706-9575
P-ISSN: 2706-9567
IJARM 2023; 5(1): 25-28
Received: 05-10-2022
Accepted: 09-11-2022

Paris Iakovidis
PT, Ph.D, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Dimitrios Lytras
PT, Ph.D, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Konstantinos Kasimis
PT, MSc, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Antonis Fetlis
PT, Ph.D, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Stefania Rafailia Ntinou
PT, MSc, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Paraskevi Chatzikonstantinou,
PT, MSc, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Corresponding Author:
Dimitrios Lytras
PT, Ph.D, Department of
Physiotherapy, Faculty of
Health Sciences International
Hellenic University - Alexander
Campus P.O. Box 141, 57 400
Sindos, Thessaloniki, Greece

Effect of resistance exercises on gait of middle-aged and older adults with Parkinson's disease

Paris Iakovidis, Dimitrios Lytras, Konstantinos Kasimis, Antonis Fetlis, Stefania Rafailia Ntinou and Paraskevi Chatzikonstantinou

DOI: <https://doi.org/10.22271/27069567.2023.v5.i1a.435>

Abstract

Parkinson's disease (PD) is a neurodegenerative condition that occurs more often in middle-aged and older adults, negatively affecting both their functional ability and quality of life. Resistance training can reduce the motor deficits caused by the disease and improve the walking ability of the patients. However, the effects of resistance exercises are disputed. The aim of this review is to highlight recent research data on the efficacy of resistance exercises as a treatment method for the improvement of motor symptoms in middle-aged and older adults with PD. The Google Scholar and PubMed databases were searched with the following keywords: "resistance training AND Parkinson's AND gait AND elderly AND middle-aged" and filtered for clinical studies published from 2010 and after. Ultimately, eight clinical studies were included in the review with a total sample of 322 PD patients. The results showed that resistance exercises are effective in improving gait, balance, and muscle strength in middle-aged and older adults with PD. However, exercise parameters are still under investigation and further research is needed on the matter to produce optimal guidelines.

Keywords: Parkinson's disease, resistance exercise, gait, balance, disability, older adults, middle-aged

Introduction

Parkinson's disease (PD) is a condition that affects the central nervous system. Specifically, brain neurons that produce dopamine are gradually lost. Symptoms of PD are mainly motor-related, i.e., resting tremors, slow movements (bradykinesia), and difficulty walking. The disease may also exhibit behavioral symptoms, such as depression and cognitive deficits [1]. Regarding prevalence, PD is a major global health concern being the second most common neurological disorder with one million people affected in the USA and seven million patients worldwide [1-3]. The disease is also correlated with age as about 1% of individuals aged over 65 are affected by PD [4]. Incidence rate is higher over the age of 60 and four times more likely in people over 80 [2].

Exercise has been shown to help limit motor deficits and slow the motor manifestations of the disease [1, 3]. Progressive resistance exercises have evoked debate on whether they are an effective therapeutic means in improving the clinical picture of patients PD. There are indications that in addition to increasing muscle strength, they can also positively affect the nervous system by limiting the motor manifestations of the disease such as bradykinesia and freezing when walking [5]. The purpose of this review is to highlight recent research data on the effect of resistance exercises on the functional ability, gait, and quality of life in patients with PD.

Method

The Google Scholar and PubMed databases were searched during September – October 2022. The following keywords were used in the search: "Resistance training AND Parkinson's AND gait AND elderly AND middle-aged". We filtered our search for clinical studies published from 2010 and after.

Results

Initially, we assessed the titles of the studies that resulted from the search process, followed by an assessment of the abstracts and, finally, a thorough examination of the full texts. In total eight clinical studies met our criteria and were included in the review. Below are their main findings, while the study summaries are presented in Table 1.

Table 1: Characteristics of the included studies

Author Year	Number of participants	Intervention duration	Intervention	Outcome measures	Conclusions
Rafferty <i>et al.</i> 2017 ^[6]	48	2 years	Group 1: resistance exercise program Group 2: multimodal exercise program	<ul style="list-style-type: none"> Gait speed Step length Gait rhythm Two-legged support time 	Both groups significantly improved all parameters without significant differences between them.
Silva-Batista <i>et al.</i> 2017 ^[7]	39	12 weeks	Group 1: educational lectures Group 2: resistance exercise program without instability Group 3: resistance exercise program with instability	<ul style="list-style-type: none"> UPDRS-III TUG 1RM 	Group 2 and 3 showed improvement in all parameters, however group 3 was more effective.
Ni <i>et al.</i> 2016 ^[8]	26	12 weeks	Group 1: health education courses Group 2: program of resistance, balance, and flexibility exercises	<ul style="list-style-type: none"> Limb bradykinesia index 1RM 	The resistance exercise program significantly reduced bradykinesia and increased muscle strength and power.
Shulman <i>et al.</i> 2013 ^[9]	67	12 weeks	Group 1: high-intensity treadmill program Group 2: low-intensity treadmill program Group 3: resistance exercise program	<ul style="list-style-type: none"> 6-minute walking test Maximal oxygen uptake 1RM 	All groups improved walking ability equally. Groups 1 and 2 had a better effect on cardiovascular function, while group 3 had a better effect on muscle strength.
Leal <i>et al.</i> 2019 ^[10]	54	6 months	Group 1: no intervention Group 2: resistance exercise program	<ul style="list-style-type: none"> Aerobic capacity Flexibility Gait speed balance 	The resistance exercise program significantly improved all parameters after six months.
Vieira-Yano <i>et al.</i> 2021 ^[11]	32	12 weeks	Group 1: program of resistance exercises, walking, balance, and stretching Group 2: resistance exercise program with instability	<ul style="list-style-type: none"> Gait autonomy Gait speed Step length 	Both groups significantly improved all parameters but group 2 appeared more effective.
Corcos <i>et al.</i> 2013 ^[12]	38	2 years	Group 1: program of stretching, balance exercises, breathing, and non-progressive resistance exercises Group 2: progressive resistance exercise program	<ul style="list-style-type: none"> UPDRS-III 	The program with progressive resistance exercises was more effective in improving mobility, enhancing walking ability.
Hass <i>et al.</i> 2012 ^[13]	18	10 weeks	Group 1: no intervention Group 2: resistance exercise program	<ul style="list-style-type: none"> Biomechanical analysis at gait initiation Gait speed Step length 	The resistance exercise group significantly improved all parameters.

Literature review

The effect of a 24-month resistance training intervention on the gait of PD patients was the research focus of Rafferty *et al.* 2017 ^[6]. Their study involved people in the age bracket of 50-67 (n = 48), who were divided into two groups. Both groups performed an exercise program, the first resistance and the second multimodal. The interventions included two sessions per week for 24 months. Researchers evaluated gait speed, length, rhythm, and two-legged support time under four different conditions. The results did not show any statistically significant difference between the two groups, albeit both improved in all examined scores.

In their study, Silva-Batista *et al.* 2017 ^[7] attempted to evaluate the role of the surface resistance exercises are performed on (stable vs. unstable) in the functional ability and gait of PD patients. The participants belonged to the 50-80 age bracket (n = 39) and were randomly allocated to three groups, two intervention and one control. The duration of the study for all groups was 12 weeks. The two intervention groups performed the same set of resistance exercises, one group on a stable surface and the other on an unstable one. Both groups attended two 50-minute sessions twice per week. The control group did not perform any exercises but attended one 60-minute educational lecture on

PD per week. The main outcome measures that were assessed were the Timed Up-and-Go (TUG) test, the Unified Parkinson Disease Rating Scale (UPDRS-III) mobility index, and muscle strength (1-Repetition Maximum - 1RM). The results showed that both intervention groups improved significantly in all evaluated measures. However, the unstable surface group had higher TUG and UPDRS-III scores. The researchers concluded that resistance exercises, especially on an unstable surface, can potentially improve motor function of PD patients.

In another study, Ni *et al.* 2016 ^[8] compared the efficacy of two therapeutic exercise protocols in 41 older adults with PD. The participants were divided into three groups (2 intervention and one control). One group followed a power training program, the other a high-speed yoga program, while the third did not receive any treatment. Both programs lasted 12 weeks with a frequency of two times a week. The UPDRS motor score, Berg Balance Scale, Mini-Balance Evaluation Systems Test, TUG test, functional reach, single leg stance, postural sway test, 10-m usual and maximal walking speed tests, 1RM, and peak power for leg press were evaluated before and after the intervention. The results of the study showed that both programs applied by the intervention groups appeared to be equally effective in

improving balance, functional ability, and gait.

Another study by Shulman *et al.* 2013^[9] attempted to assess the gait speed and strength of 67 individuals with PD after participating in three separate exercise programs. Participants were divided into three groups, one for each program. The first group followed a 30-minute high-intensity (70-80% VO_{2max}) exercise program on a treadmill, the second group a 50-minute low-intensity (40-50% VO_{2max}) exercise program on a treadmill, and the third group performed resistance exercises and stretching. The duration of all interventions was three months with three sessions per week. Outcome measures included gait speed with six-minute walking test, 1RM, and maximal oxygen uptake per time unit. The results showed that all groups improved their evaluated parameters after the intervention. Regarding between-group differences, the third group exhibited higher 1RM values, whereas the treadmill groups improved more their cardiovascular function.

The study of Leal *et al.* 2019^[10] focused on low-intensity resistance exercises and their effect on 54 older adults (aged over 60) with PD, who were randomly allocated to two groups (intervention and control). The intervention group followed a resistance exercise program while also continuing their PD medication. The control group just received their regular medication with no exercise. The duration of the intervention was six months with two sessions per week for the first group. Outcome measures included flexibility, gait speed, balance, and aerobic capacity. The results showed that after the intervention the first group improved in all evaluated areas, in contrast to the control group who deteriorated.

Moreover on resistance exercises, Vieira-Yano *et al.* 2021^[11] examined their efficacy when combined with instability in improving gait in 32 patients aged 50-85, who were randomly allocated to two groups (intervention and control). The intervention group followed a free weights upper and lower limb resistance exercise program combined with instability devices (e.g., BOSU). The control group performed stretching and similar free weights upper and lower limb exercises for balance and gait but without the instability devices. The intervention for both groups lasted 12 weeks with three 80- to 90-minute sessions per week. The researchers evaluated gait autonomy, speed, and length. Both groups improved in all assessed gait aspects, however, the intervention group even more so.

The study of Corcos *et al.* 2013^[12] added progressive difficulty when investigating the effect of resistance exercises in PD patients. The sample was 51 individuals with PD, aged 50-67, and divided randomly into two groups. The first group followed a training program that involved balance, resistance, and breathing exercises, as well as stretching. The second group followed a progressive upper and lower limb resistance exercise program. Both groups followed their respective programs for 24 months with two sessions per week. To be noted is that 13 participants dropped out of the study at various time points. The UPDRS-III was used to assess the motor function of the participants. The results showed that the group who followed the progressive resistance program improved significantly more their motor function and walking ability. Finally, Hass *et al.* 2012^[13] also studied the effect of resistance exercises in gait in people with PD. Their work involved 18 PD patients aged 57-75, who were randomly allocated to two groups (intervention and control). The

intervention group followed a resistance exercise program, while the control group did not receive any intervention (Exercise nor education). The intervention duration was 10 weeks with two sessions per week for the first group. Outcome measures included the displacement of the center-of-pressure during the anticipatory postural phase of gait initiation and the initial stride length and velocity. The results revealed an improvement for the intervention group in all areas and none for the control group.

Discussion-Conclusions

Our review aimed to study the effect of resistance exercises on the functional ability and gait of patients with PD. In all the included studies resistance exercise programs were implemented while the participants were mainly older adults as well as middle-aged individuals. The results of our review showed that a resistance training program is more effective than a control group^[8, 10] and equally effective when compared to combined exercise programs^[6]. Additionally, performing resistance exercises on an unstable surface appears to improve gait and balance parameters more than performing them on a stable surface^[7].

It seems that 12 weeks of participation in a progressive resistance program improves strength, functional ability, balance, and gait in patients with PD. More studies are needed in the future to identify the optimal parameters that can have the best results. The matter requires further investigation.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Kottaras A, Lytras D, Kottaras S, Iakovidis P. The Effect of Aquatic Physiotherapy on Functioning, Balance Performance, Motor Performance and Health-related Quality of Life in Patients with Parkinson's Disease: A Review of. *Crit Rev Phys Rehabil Med.* 2021;33(1):65-84. doi:10.1615/critrevphysrehabilmed.2021038050
2. De Lau LM, Breteler MM. Epidemiology of Parkinson's Disease. *Lancet Neurology.* 2006;5:525-535. doi:10.1016/S1016-3190(10)60044-4
3. Kottaras A, Lytras D, Iakovidis P, Chatziprodrimidou IP, Myrogiannis IS, Apostolou T. The Effect of Therapeutic Exercise on the Clinical Picture and Quality of Life of Patients with Parkinson's Disease: A Narrative Review and Update of Evidence-Based Physiotherapy Practice, 2022. www.begellhouse.com
4. Ascherio A, Schwarzschild MA. The epidemiology of Parkinson's disease: risk factors and prevention. *Lancet Neurol.* 2016 Nov;15(12):1257-1272. Doi:10.1016/S1474-4422(16)30230-7.
5. Hirsch MA, Farley BG. Exercise and neuroplasticity in persons living with Parkinson's disease. *Eur J Phys Rehabil Med.* 2009;45(2):215-229.
6. Rafferty MR, Schmidt PN, Luo ST, Li K, Marras C, Davis TL. All NPF-QII Investigators. Regular Exercise, Quality of Life, and Mobility in Parkinson's Disease: A Longitudinal Analysis of National Parkinson Foundation Quality Improvement Initiative Data. *J*

- Parkinsons Dis. 2017;7(1):193-202. doi:10.3233/JPD-160912
7. Silva-Batista C, Corcos DM, Barroso R, David FJ, Kanegusuku H, Forjaz C. Instability resistance training improves neuromuscular outcome in Parkinson's disease. *Med Sci Sports Exerc.* 2017;49(4):652-660. doi:10.1249/MSS.0000000000001159
 8. Ni M, Signorile JF, Mooney K, Balachandran A, Potiaumpai M, Luca C. Comparative Effect of Power Training and High-Speed Yoga on Motor Function in Older Patients With Parkinson Disease. *Arch Phys Med Rehabil.* 2016 Mar;97(3):345-354.e15. doi: 10.1016/j.apmr.2015.10.095
 9. Shulman LM, Katzel LI, Ivey FM, Sorkin JD, Favros K, Anderson KE. Randomized clinical trial of 3 types of physical exercise for patients with Parkinson disease. *JAMA Neurol.* 2013 Feb;70(2):183-90. doi: 10.1001/jamaneurol.2013.646
 10. Leal LC, Abrahin O, Rodrigues RP, da Silva MC, Araújo AP, de Sousa EC. Low-volume resistance training improves the functional capacity of older individuals with Parkinson's disease. *Geriatr Gerontol Int.* 2019;19(7):635-640. doi:10.1111/ggi.13682
 11. Vieira-Yano B, Martini DN, Horak FB, de Lima-Pardini A, Almeida F, Santana VP. The Adapted Resistance Training with Instability Randomized Controlled Trial for Gait Automaticity. *Mov Disord.* 2021;36(1):152-163. doi:10.1002/mds.28298
 12. Corcos DM, Robichaud JA, David FJ, Leurgans SE, Vaillancourt DE, Poon C. A two-year randomized controlled trial of progressive resistance exercise for Parkinson's disease. *Mov Disord.* 2013 Aug;28(9):1230-40. doi: 10.1002/mds.25380.
 13. Hass CJ, Buckley TA, Pitsikoulis C, Barthelemy EJ. Progressive resistance training improves gait initiation in individuals with Parkinson's disease. *Gait Posture.* 2012;35(4):669-673. Doi:10.1016/j.gaitpost.2011.12.022

How to Cite This Article

Iakovidis P, Lytras D, Kasimis K, Fetlis A, Ntinou SR, Chatzikonstantinou P. Effect of resistance exercises on gait of middle-aged and older adults with Parkinson's disease. *International Journal of Advanced Research in Medicine.* 2023;5(1):25-28.

Creative Commons (CC) License

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.