International Journal of Health Sciences and Research
Vol.13; Issue: 5; May 2023
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Effect of Core Muscle Training on Improving Balance and Gait performance in Idiopathic Parkinson's Disease

Megha Dath T.S[1], Remya N[2], Manju Unnikrishnan[3], Reethu Elsa Baby[4], Reeba Roy[5], Rakhi Balagopal[6]

[1]Post graduate student, Little Flower Institute of Medical and Research Centre, Angamaly, Kerala
[2]Professor and HOD, Little Flower Institute of Medical and Research Centre, Angamaly, Kerala
[3]Professor, Little Flower Institute of Medical and Research Centre, Angamaly, Kerala
[4,5,6]Associate Professor, Little Flower Institute of Medical and Research Centre, Angamaly, Kerala

Corresponding Author: Megha Dath T.S

DOI: https://doi.org/10.52403/ijhsr.20230518

ABSTRACT

Background: Parkinson's disease (PD) is a neurodegenerative disease that consists of a progressive loss of dopaminergic neurons, involving motor symptoms such as tremor, muscular rigidity, hypokinesia and postural instability. Subjects with Parkinson's disease frequently present impaired postural control that leads to loss of balance and impaired gait performance. Evidences showed that there is a significant correlation between trunk mobility, balance and gait in subjects with Parkinson's disease. So more severe is the trunk mobility in the Parkinson's disease patient, more will be the difficulties with Balance and Gait

Objectives: To determine the effect of core muscle training on improving balance and gait performance in Idiopathic Parkinson's disease

Materials and method: Thirty subjects were divided into two groups with 15 in each. Group A received core muscle training, with conventional exercise while Group B received conventional physiotherapy alone. Duration of treatment was 5 days /week for 6 weeks. Outcome measures were Tinetti POMA – Balance component and Functional Gait Assessment (FGA) used to assess balance and gait respectively. Pre score was taken before the first session and post score was taken after 6 weeks

Results: There is statistically significant ($p<0.05$) difference between Group A and Group B. Group A showed greater statistically significant improvement in Tinetti POMA- Balance Component and FGA when compared with Group B

Conclusion: This study primarily tried to analyze the effects of core muscle training along with conventional Physiotherapy on balance and gait performance in IPD patients and this study reveals that addition of core muscle training with conventional physiotherapy enhances faster recovery in patients with IPD

Keywords: Core muscle training; Balance; Gait performance; Idiopathic Parkinson's disease.

INTRODUCTION

Parkinson's disease (PD) is a neurodegenerative disease that consists of a progressive loss of dopaminergic neurons, involving motor symptoms such as tremor, muscular rigidity, hypokinesia and postural instability.[1] Idiopathic Parkinson's Disease (IPD) refers to those cases where etiology is unknown or genetically determined.[2] IPD is the second most common neurodegenerative disease after Alzheimer's disease.[3] The clinical hallmark of IPD includes

bradykinesia, resting tremor, postural instability and gait disturbance.[3] A reduction in strength is evident in subjects with PD.[4] Torque production is decreased at all speeds resulting in activity limitations and muscle weakness in PD.[4] Kinesthetic deficits are genuine manifestations of Parkinson's disease that may occur very early in the disease process and may even precede the known motor problems in PD.[5] Activities of daily living (ADL) and muscle power is impaired in PD.[4] PD leads to reduced health related quality of life and high health care costs.[6]

PD occur in about 1% of population older than 65 years of age and become increasingly common with advancing age.[7] The mean age of onset is between 58 and 62 years of age with majority of cases having their onset between the age of 50 and 79. Males are slightly more at risk for developing PD than females.[8, 9] IPD is observed in all countries, all ethnic groups and all socioeconomic classes.[9] Asians showed 11.3 per 100,000 while whites showed 16.6 per 100,000 and Parkinson's disease rate among Asians appears to be lower than those of whites.[9]

PD affects an estimated 7 to 10 million people worldwide.[10] It is rare before age 50 years and the prevalence increases with age up to 4% in the highest age group.[11] The population is more than 1 billion, the number of subjects with PD in India is estimated to be 7 million.[11]

The increased axial rigidity that is evident in people with PD, significantly impairs trunk capacity to attenuate the movement related forces.[12] Axial rigidity is an evident incapacitating trait responsible for abnormal walking in subjects with PD.[13] Disturbance in controlling axial segments may underlie many of the gait and postural impairments in PD.[14] The biomechanical research involving healthy younger adults has shown that the trunk segment plays an important role in modulating gait related oscillations and maintaining head stability.[15] According to Priya Desai et al, there is a significant correlation between trunk mobility, balance and gait in subjects with Parkinson's disease.[16] The study concluded that more severe is the trunk mobility in the PD patient, more will be the difficulties with balance and gait.[16] Previous studies in stroke have also reported that trunk function is associated with balance and walking ability in stroke patients. [13,17]

Subjects with PD frequently present impaired postural control that leads to loss of postural stability.[18] Postural control aids the core of the body adapt to a new posture while performing a particular exercise by preparing the body for unstable postures while moving the arms and legs.[19] Core is the biggest part of our body and plays an important role in stabilization and movement of body segment.[19] Core stability is essential for proper load balance within the spine, pelvis and kinetic chain.[20] Core muscle coordination is important because lack of sufficient core muscle coordination can lead to decreased efficiency of postural control and functional activity.[18] The trunk plays an integral role in postural stabilization supporting controlled movement of the extremities during task performance.[21] Studies has proved the significant correlation between trunk mobility, balance and gait in subjects with PD. Nevertheless, there is paucity of literature proving the effect of core muscle training on balance and gait performance in IPD. The purpose of the study is to find the effect of core muscle training in improving balance and gait performance in Idiopathic Parkinson's Disease.

MATERIALS AND METHODS

PARTICIPANTS

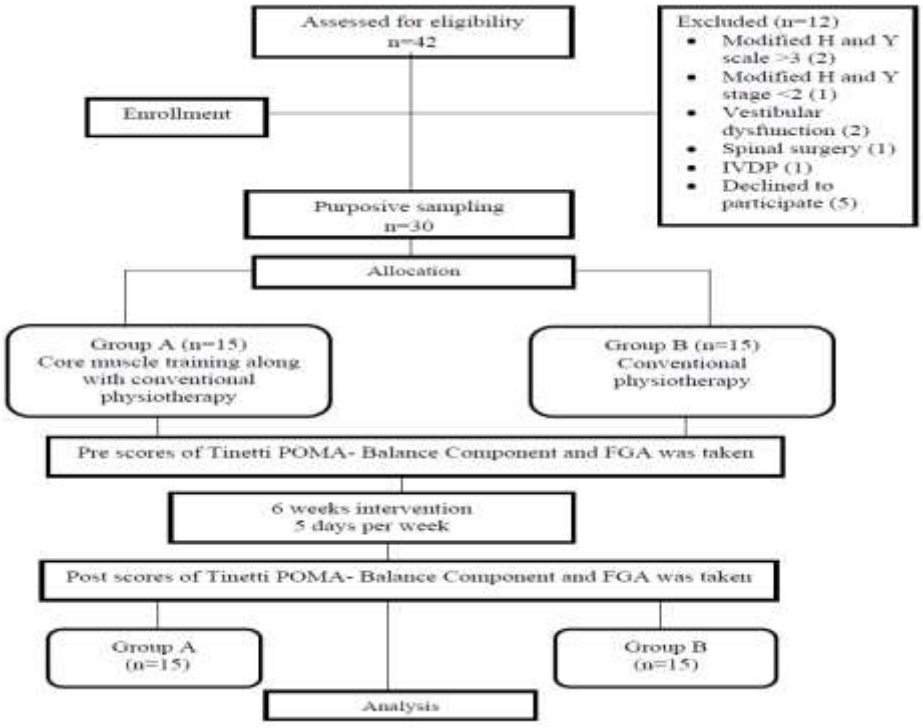
A total of 30 subjects clinically diagnosed with Parkinson's disease, who fulfilled the inclusion criteria were randomly assigned into two groups. Subjects were recruited from Department of Neurology and Physiotherapy, Little Flower Hospital and Research Centre, Angamaly. Ethical clearance was obtained from the Institutional Review Board and Ethical Committee of the institution. 30 subjects

who fulfilled the inclusion criteria were randomly assigned into two groups: 15 in group A and 15 in Group B. Written informed consent was obtained from the subjects. Subjects in Group A received Core muscle training along with conventional exercises, whereas subjects in Group B received conventional physiotherapy alone. All subjects met the following inclusion criteria: (1) clinically diagnosed cases of IPD (2) 2, 2.5, 3 Modified Hoehn and Yahr staging (3) age 50-65 years (4) on stage of levodopa (5) MoCA score greater than or equal to 26. Subjects were excluded with following exclusion criteria: (1) medically unstable subjects (2) subjects with autonomic instability (3) subjects with secondary PD, parkinsonism plus syndrome (4) inflammatory, infective, demyelinating disorders of central nervous system(5) vestibular dysfunction (5) recent fractures (6) psychiatric and non-cooperative subjects (7) intervertebral disc prolapse and other diseases of spine (8) subjects undergone spinal surgeries (9) all other neurological disorders (10) subjects participating in any other exercise programme. Subjects were required to sign a written informed consent document approved by the ethical committee at Little Flower Hospital and Research Centre, Angamaly.

STUDY DESIGN

This study was an RCT, pre-test post-test experimental design taking place during study period. After obtaining approval from ethical committee, thirty subjects were randomly allocated into two groups by the investigator who was involved in data collection, treatment implication and data analysis. A total of 42 subjects clinically diagnosed with Parkinson's disease were assessed for eligibility and 30 subjects who fulfilled the inclusion criteria were randomly assigned into two groups. Subjects in group A (experimental group) received core muscle training along with conventional physiotherapy, while subjects in group B (control group) received conventional physiotherapy alone. Duration of the treatment was 5 days/week for 6 weeks. Baseline assessments were done after randomization, at the beginning of the treatment session and at the last day of treatment.

Fig (1) Consort Flow chart



REHABILITATION PROGRAMME

	EXERCISE IN SUPINE POSITION	EXERCISE IN SITTING POSITION	EXERCISE IN QUADRUPED POSITION
1-2 weeks	Crook lying Abdominal bracing Bracing with heel slides Bracing with leg lifts Bracing with bridging Lower trunk rotation Sit up with hands grasp together Oblique sit ups with hands extended	Forward reach with hands grasping together Upper trunk rotation with hands cross to the chest Lower trunk rotation Shuffling anterior and posterior Lateral flexion of trunk initiated from shoulder Lateral flexion of trunk initiated from pelvic girdle	Nil
2-4 weeks	Lower trunk rotation by grasping a ball in between the knees Upper trunk flexion rotation, moving the hand diagonally to grab the knees Crook lying, crossing one leg over the other leg	Forward reach Lateral reach Hand grasp and multidirectional reach Sit to stand	Cat and camel exercises Quadruped arm lifts with bracing Quadruped leg lifts with bracing Quadruped arm and leg lifts with bracing
4-6 weeks (Exercise on physioball)	Pelvic bridge Lower trunk flexion rotation Upper trunk rotation	Forward reach Multidirectional reach Upper trunk lateral flexion Lower trunk lateral flexion Upper trunk rotation Lower trunk rotation Weight shifting Sit to stand	Nil
Conventional exercise programme	Gentle rocking and rotational exercises Supine lying , side to side head rotation Hook lying, lower trunk rotation Side lying, upper and lower trunk rotation Active range of motion exercise to upper limb Active range of motion exercise to lower limb PNF exercise- D1 flexion/extension and D2 flexion/ extension to both upper limb and lower limb Stretching –quadriceps, hamstrings, gastrocnemius, iliopsoas Posture maintaining exercise		

RESULTS

The obtained data was analyzed using SPSS version 20.00. Baseline homogeneity was established using Shapiro Wilk test as the sample size was 30. Descriptive statistics were used to present the baseline characteristics of the data. The pre and post values of Tinetti POMA- Balance Component and FGA were analyzed using Paired t- test for data that follows normality and Wilcoxon Signed Rank test for data that doesn't follows normality for within group analysis. As the outcome variables Tinetti POMA- Balance Component and FGA were not normally distributed, between group analysis was done using Mann- Whitney U test. Since the calculated values are greater than table value (Z=1.96, T=2.145), there is statistically significant improvements in Tinetti POMA- Balance Component and FGA scores in both groups ($p<0.05$). Since all the obtained values were greater than the table value, there is statistically significant difference between Group A and Group B ($p<0.05$). Group A showed more statistically significant improvement in Tinetti POMA- Balance Component and FGA compared to Group B.

Thus from the obtained results, it can be inferred that there is significant effect on core muscle training along with conventional physiotherapy in improving balance and gait performance when compared to conventional physiotherapy alone in subjects having IPD.

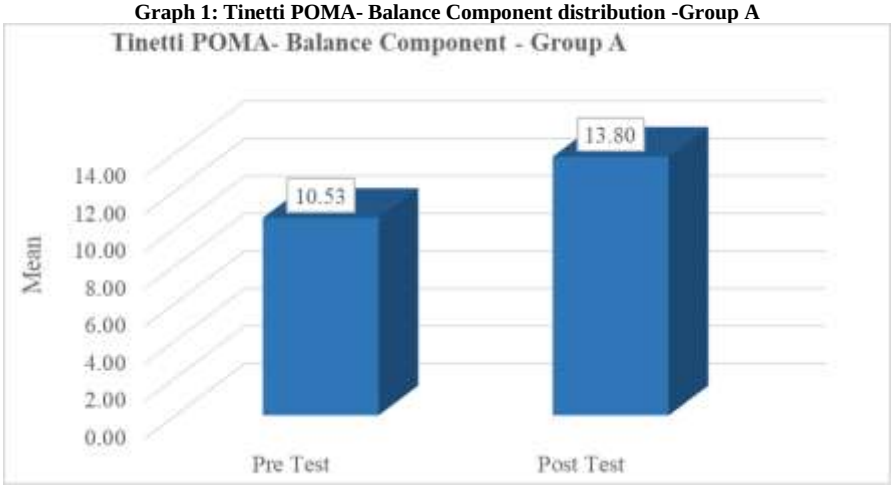
Table 1: Demographic data

Group A		Mean	SD	Percentage	
				Female	Male
	Age	61.73	±3.67	-	-
	Gender	-	-	46.7	53.3
	Ipd duration	4.93	±1.62	-	-
	H and Y	2.60	±.280	-	-
Group B	Age	60.07	±3.958	-	-
	Gender	-	-	46.7	53.3
	Ipd duration	4.07	±1.28	-	-
	H and Y	2.63	±.229	-	-

Table 2: Statistical results- within group comparison Tinetti POMA- Balance component

GROUP	Pre-test scores	Post-test scores	Mean deviation	t Value	z Value	p Value
Group A	10.53±1.68	13.80±1.37	3.27±1.03	----	3.43	0.001
Group B	10.33±2.28	11.60±2.41	1.26±.704	6.97	----	0.000

Graph 1: Tinetti POMA- Balance Component distribution -Group A



Graph 2: Tinetti POMA- Balance Component distribution -Group B

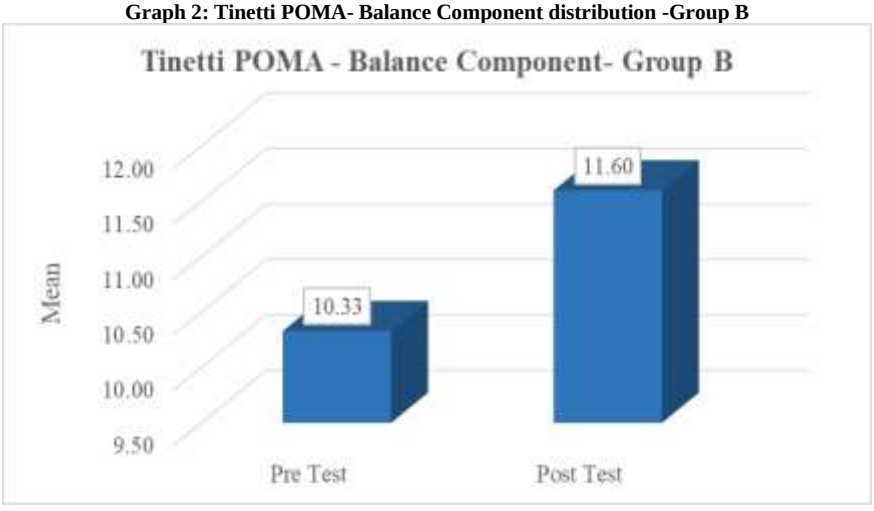


Table 3: Statistical results- between group analysis

Tinetti POMA- Balance	N	Mean Difference	Standard Deviation	z	p
Group A	15	3.27	1.033	4.291	0.000
Group B	15	1.27	.704		

Mann- Whitney U test, $p<0.05$ considered as statistically significant

Graph 3: Tinetti POMA- Balance Component distribution in Group A and Group B

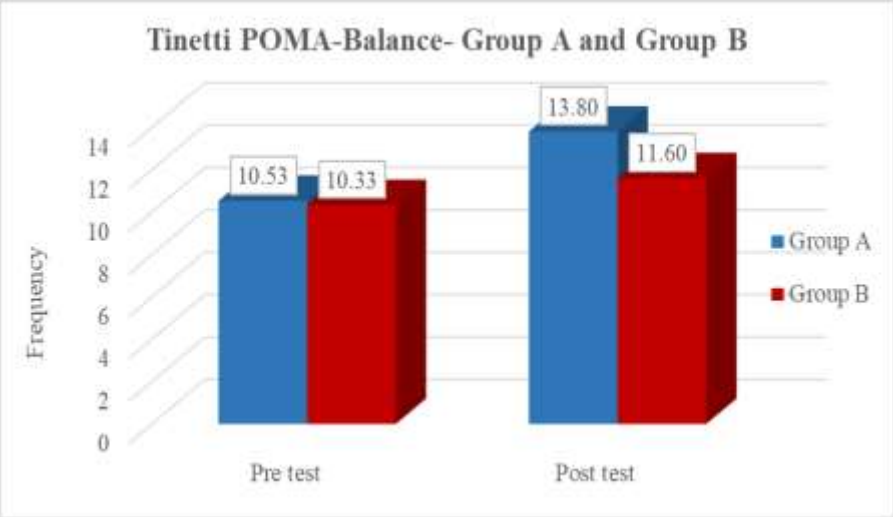
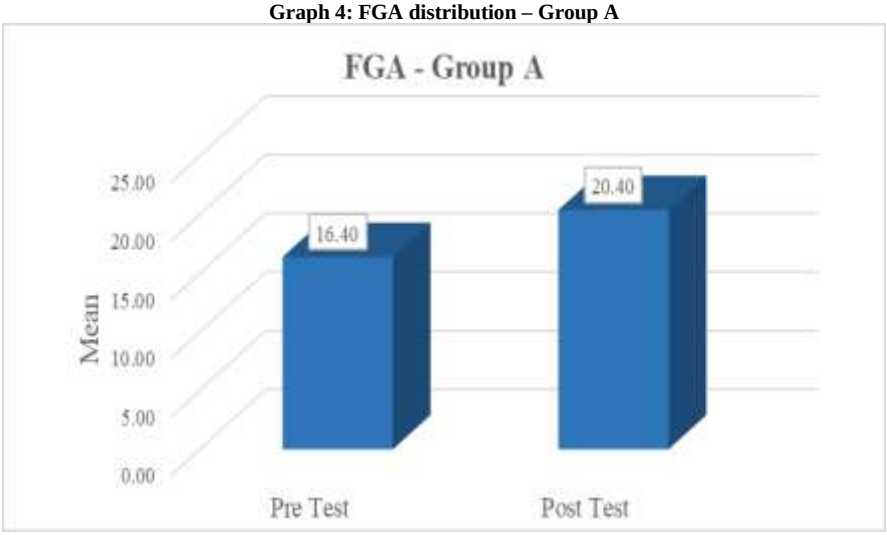


Table 4: Statistical results- within group analysis FGA

GROUP	Pre-test scores	Post-test scores	Mean deviation	t Value	p Value
Group A	16.40±3.62	20.40±3.56	4.00	10.24	0.000
Group B	18.47±4.86	20.07±4.84	1.61	9.79	0.000

Graph 4: FGA distribution – Group A



Graph 5: FGA distribution – Group B

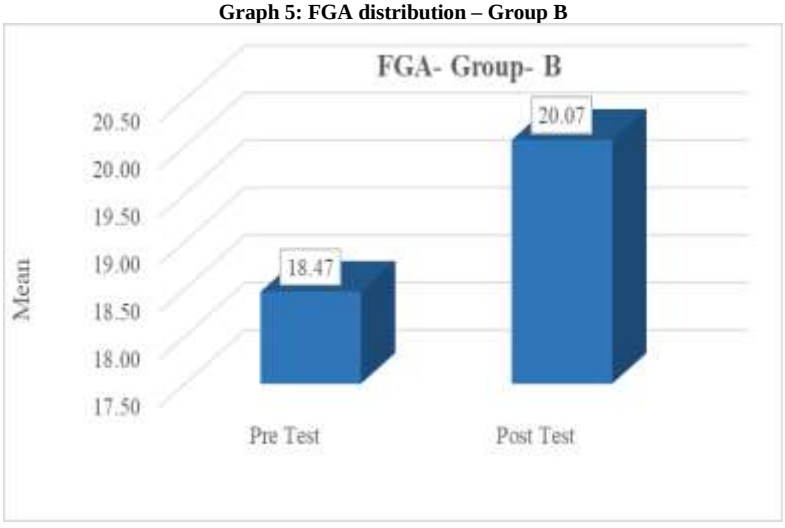
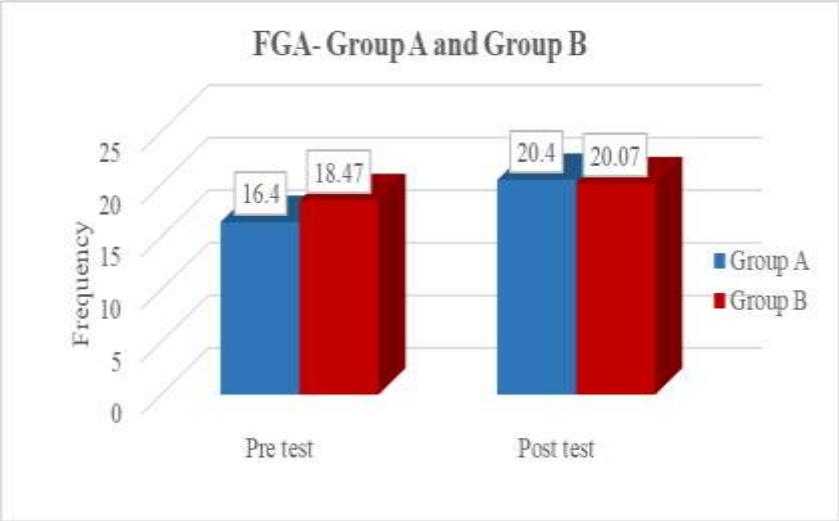


Table 5: Statistical results- between group analysis

FGA	N	Mean Difference	Standard Deviation	z	p
Group A	15	4.00	1.512	4.459	0.000
Group B	15	1.60	0.632		

Graph 6: FGA distribution in Group A and Group B



DISCUSSION

30 diagnosed cases of IPD who met the inclusion criteria were divided into two groups of 15 each, Group A and Group B. Group A received core muscle training along with conventional physiotherapy whereas Group B received conventional physiotherapy alone. The total duration of the intervention was 6 weeks.

The outcome measures used were Tinetti POMA Balance Component and FGA. It has been shown to be the valid and reliable tool for the measurement. The assessment were taken on the first day before and last day after the treatment. The results showed significant improvement in balance and gait performance in both groups. Group A showed more improvement in Tinetti POMA- Balance Component and FGA than Group B. It indicates that core muscle training along with conventional physiotherapy is effective to improve balance and gait performance in Idiopathic Parkinson's disease.

Reduction in muscle strength, decrease in torque production, flexibility and kinesthetic deficits are manifestations of PD.[4,5] According to Shankar et al in 2004, core muscle stabilization exercises improve strength, endurance, proprioception and flexibility of trunk muscles. This can be one of the reason for improvement in balance.[22]

Trunk plays an integral role in postural stabilization and supports controlled movement of extremities during task performance.[21, 23] Rosa Cabanas in 2017 stated that 5 weeks of core stability exercise induce co-contraction of the trunk muscles and improved the intersegmental coordination restricted to the degree of freedom of the body and allow a more selective movement control of lower limb.[24] The exercise given to core muscles have helped in increasing co-contraction and improving the intersegmental coordination and thereby the balance and gait performance.[24]

Core is the biggest part of our body and plays an important role in stabilization and movement of the body segment.[25] Core stability is defined as the ability to control position and motion of the trunk over the pelvis and leg to optimal production, transfer and control of forces and motion to the terminal segment in integrated kinetic chain activities.[26] The process of using force generated in the trunk and transferring to the extremities is referred to as serape effect.[27] Core muscles work together to establish core strength that can be stored as potential

energy and then transferred into kinetic energy for force production in the upper and lower extremities.[27]

Core stability is essential for proper load, balance within the spine, pelvis and kinetic chain.[20] Sequenced physiologic muscle activation in the upper and lower extremity result in an integrated biomechanical task, this sequencing is known as Kinetic chain.[28] Core drives the kinetic chain function and promote a properly functioning kinetic chain system.[16, 28] Kibler W.B et al in 2012 stated that in order for the task to be effective and efficient, the kinetic chain links that different segments of the body must have optimal amounts of muscle flexibility, strength, proprioception and endurance.[29] The findings of the study showed the efficient functioning of core muscles. Hence core muscle training has led to proper functioning of kinetic chain and improving balance and gait performance in subjects with PD.

Proximal stability is the prerequisite for distal mobility.[28] Studies proved that there is a significant correlation between trunk mobility, balance and gait in subjects with Parkinson's disease.[16] It can be inferred that core muscle training may have helped in proper functioning of the core and improvement in the trunk stability and mobility and thus the balance and gait.

The increased axial rigidity that is evident in PD significantly impairs trunk capacity to attenuate the movement related forces and may underlie many of the gait and postural impairments.[12,14] Petzinger G. M et al in 2015 stated that exercise showed increased dopamine release.[30] The reduction in axial rigidity and improvement in flexibility and power of core muscle has led to the proper functioning of kinetic chain and effective transfer of energy to the lower extremity. This resulted in the improvement of balance and gait performance in subjects with IPD.

The present study showed the effect of core muscle training on balance and gait. The findings of the study imply that core muscle training is effective in improving gait and balance in IPD.

CONCLUSION

Statistical analysis of the data collected recommends that core muscle training along with conventional physiotherapy have significant effect on balance and gait performance in Idiopathic Parkinson's disease than conventional physiotherapy alone.

Hence the study reveals that, addition of core muscle training with conventional physiotherapy enhances the balance and gait performance in Idiopathic Parkinson's disease.

Thus, it can be concluded that core muscle training along with conventional physiotherapy are effective in improving balance and gait performance in Idiopathic Parkinson's disease.

List Of Abbreviation Used

FGA	:	Functional Gait Assessment
Modified H and Y scale	:	Modified Hoehn and Yahr
IPD	:	Idiopathic Parkinson's disease
MoCA	:	Montreal cognitive Assessment
Tinetti POMA	:	Tinetti Performance Oriented Mobility Assessment

AUTHOR'S CONTRIBUTIONS: The author's confirm contribution to the paper as follows: study conception and design: Megha Dath T.S and Remya N; Data Collection: Megha Dath T S; Analysis and Interpretation; Manju Unnikrishnan, Reeba Roy, Rakhi Balagopal; Draft manuscript: Megha Dath T S, Remya N, Reethu Elsa Baby. All the authors reviewed the results and approved the final version of the manuscript.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: Very great appreciation to all for the valuable suggestions and co-operations for the success of this research work.

Source of Funding: There was no external source of funding received for this research work.

Conflict of Interest: The authors agree that there were no competing interests

REFERENCE

1. Hoehn MM, Yahr MD. Parkinsonism: onset, progression, and mortality. Neurology. 1967 May 1; 17(5):427-442.
2. Zetusky WJ, Jankovic J, Pirozzolo FJ. The heterogeneity of Parkinson's disease: clinical and prognostic implications. Neurology. 1985 Apr 1; 35(4): 522.
3. Antony PM, Diederich NJ, Kruger R, Balling R. The hallmarks of Parkinson's disease. The FEBS journal. 2013 Dec 1; 280(23):5981-5993.
4. Corcos DM, Robichaud JA, David FJ, Leurgans SE, Vaillancourt DE, Poon C, Rafferty MR, Kohrt WM, Comella CL. A two-year randomized controlled trial of progressive resistance exercise for Parkinson's disease. Movement Disorders. 2013 Aug; 28(9):1230-1240.
5. Konczak J, Corcos DM ,Horak F , Poizner H, Shapiro M, Tuite P, Volkmann J, Maschke M. Proprioception and Motor Control in Parkinson's Disease. Journal of Motor Behavior. 2009 Nov; 41(6):543-552.
6. Tickle Degnen L, Ellis T, Saint Hilaire MH, Thomas CA, Wagenaar RC. Self-management rehabilitation and health-related quality of life in Parkinson's disease: A randomized controlled trial. Movement Disorders. 2010 Jan 30; 25(2):194-204.
7. Hirtz D, Thurman DJ, Gwinn Hardy K, Mohamed M, Chaudhuri AR, Zalutsky R. How common are the "common" neurologic disorders? Neurology. 2007 Jan 30; 68(5):326-337.
8. PD foundation: Statistics on PD. 2012 Apr 22. www.pdf.org/en/parkinsons- statistics.
9. Van Den Eeden SK, Tanner CM, Bernstein AL, Fross RD, Leimpeter A, and Bloch DA et al. Incidence of Parkinson's disease: variation by age, gender, and race/ethnicity. American Journal of Epidemiology. 2003 Jun 1; 157(11):1015-1022.
10. Susan B O Sullivan, Thomas J Schmitz, George D Fulk. Parkinson's disease. Physical rehabilitation. 6th ed. United States of America: F.A. Davis Company; 2014. p.807.
11. Madhuri Behari. PD in India. Lancet Publishing. 2002 Aug.
12. Franco CR, Leao P, Townsend R, Rieder CR. Reliability and validity of a scale for measurement of trunk mobility in Parkinson's disease: Trunk Mobility Scale. Arquivos de Neuro-Psiquiatria. 2011 Aug; 69(4):636-641.
13. Jijimol G, Fayaz RK, Vijesh PV. Correlation of trunk impairment with balance in patients with chronic stroke. NeuroRehabilitation. 2013 Jan 1; 32(2):323-325.
14. Wright WG, Gurfinkel VS, Nutt J, Horak FB, Cordo PJ. Axial hypertonicity in Parkinson's disease: direct measurements of trunk and hip torque. Experimental Neurology. 2007 Nov 1; 208(1):38-46.
15. Hubble RP, Naughton GA, Silburn PA, Cole MH. Trunk muscle exercises as a means of improving postural stability in people with Parkinson's disease: A protocol for a randomized controlled trial. BMJ open. 2014 Dec 1; 4(12):6095.
16. Desai P, Paul Daniel VK, Lama B. Correlation of trunk mobility with balance and gait in patients with Parkinsonism. International Journal of Yoga, Physiotherapy and Physical Education. 2018 Sep; 3(5):7-11.
17. Verheyden G, Vereeck L, Truijen S, Troch M, Herregodts I, Lafosse C, Nieuwboer A, De Weerdt W. Trunk performance after stroke and the relationship with balance, gait and functional ability. Clinical Rehabilitation. 2006 May; 20(5):451-458.
18. Marie V.C et al. Core stability and PD. US National Library of Medicine. 2018.
19. Yu SH, Park SD. The effects of core stability strength exercise on muscle activity and trunk impairment scale in stroke patients. Journal of exercise rehabilitation. 2013 Jun; 9(3):362- 367.
20. Akuthota V, Ferreiro A, Moore T, Fredericson M. Core stability exercise principles. Current Sports Medicine Reports. 2008 Jan 1; 7(1):39-44.
21. Gillen G, Boiangiu C, Neuman M, Reinstein R, Schaap Y. Trunk posture affects upper extremity function of adults. Perceptual and Motor Skills. 2007; 104:371-380.
22. Shankar G, Chaurasia V, Zambare PD. Effect of Core Stabilization Exercise in

Improving Trunk Endurance. International Journal of Health Sciences and Research. 2011 Oct; 1(1):1-6.
23. Hsieh C, Sheu C, Hsueh I, Wang C. Trunk control as an early predictor of comprehensive activities of daily living function in stroke patients. Stroke. 2002; 33:2626-2630.
24. Cabanas-Valdes R, Bagur-Calafat C, Girabent-Farres M, Caballero-Gomez FM, Hernandez-Valino M, Urrutia Cuchi G. The effect of additional core stability exercises on improving dynamic sitting balance and trunk control for subacute stroke patients: a randomized controlled trial. Clinical rehabilitation. 2016 Oct; 30(10):1024-33.
25. Sebastia E, Duarte E, Boza R, et al. Cross-validation of a model for predicting functional status and length of stay in patients with stroke. Journal of Rehabilitation Medicine. 2006; 38: 204-206.
26. Wilkerson GB, Giles JL, Seibel DK. Prediction of core and lower extremity strains and sprains in collegiate football players: a preliminary study. Journal of Athletic Training. 2012 May; 47(3):264-272.
27. Konin JG, Beil N, Werner G. Facilitating the serape effect to enhance extremity force production. International Journal of Athletic Therapy and Training. 2003 Mar 1; 8(2):54-6.
28. Sciascia A, Cromwell R. Kinetic chain rehabilitation: a theoretical framework. Rehabilitation Research and Practice. 2012 May 14; 2012.
29. Kibler WB, Press J, Sciascia A. The role of core stability in athletic function. Sports medicine. 2006 Mar 1; 36(3):189-98.
30. Petzinger GM, Holschneider DP, Fisher BE, McEwen S, Kintz N, Halliday M, Toy W, Walsh JW, Beeler J, Jakowec MW. The effects of exercise on dopamine neurotransmission in Parkinson's disease: targeting neuroplasticity to modulate basal ganglia circuitry. Brain plasticity. 2015 Jan 1; 1(1):29-39.

How to cite this article: Megha Dath T.S, Remya N, Manju Unnikrishnan et.al. Effect of core muscle training on improving balance and gait performance in idiopathic Parkinson's disease. *Int J Health Sci Res.* 2023; 13(5):166-175.
DOI: *https://doi.org/10.52403/ijhsr.20230518*

******