International Journal of Physiotherapy and Research,
Int J Physiother Res 2024, Vol 12(4):4768-75. ISSN 2321-1822
DOI: https://dx.doi.org/10.16965/ijpr.2024.126

Original Research Article

Effect of Brain Gym Exercise in Addition to Balance Exercises Versus Balance Exercises on Fear of Fall and Balance in Patients with Parkinsonism

Saylee Pravin Phatak [1], Sabah Thaver *[2], Ali Irani [3].

[1] Post Graduate Student, Department of Physiotherapy, Sunandan Divatia School of Science, SVKM'S NMIMS (Deemed to Be) UNIVERSITY, Vile Parle, Mumbai, Maharashtra, India.

[*2] Assistant professor Department of Physiotherapy, Sunandan Divatia School of Science, SVKM'S NMIMS (Deemed to Be) UNIVERSITY, Vile Parle, Mumbai, Maharashtra, India.

[3] Head of the department, Department of Physiotherapy, Nanavati Max Supers speciality hospital, Vile Parle, Mumbai, Maharashtra, India.

ABSTRACT

Background: The clinical syndrome of Parkinsonism is typified by bradykinesia, rigidity, rest tremor, and postural instability. The main cause is idiopathic Parkinson disease (PD), but there are additional significant factors to take into account. Compared to the overall elderly population, where the annual fall rate is roughly 30%, its prevalence is noticeably higher. One major PD symptom that significantly increases the risk of falls is postural instability. Fall risk is greatly increased by the typical Parkinsonian gait, which consists of shuffling, less arm swing, and small steps. Parkinson's patients fear falling because of a combination of their ingrained vulnerability awareness and motor symptoms. Engaging the motor and sensory cortices to mechanically activate both hemispheres of the brain, Brain Gym consists of a series of balanced, coordinated cross-lateral movements. Through vestibular system stimulation, it lowers the flight or fight response and improves equilibrium. Between other aspects of Parkinsonism, Brain Gym—which consists of 26 simple exercises—may help with balance control and fall fear.

Aim And Objective: To assess the effect of brain gym exercise in addition to balance exercises versus balance exercises on fear of fall and balance in patients with parkinsonism.

Method: A total of 50 subjects participated in the study. Subjects were screened according to the inclusion and exclusion criteria. Baseline outcome measures which included MINIBESTest and Fall Efficacy Scale-International assessed. Subjects were randomly allotted into two groups. Intervention was given, Group A was the control group where conventional protocol was given for improving hand functions. Group B was the intervention group where upper quadrant muscles strengthening exercises were given along with the conventional protocol. The outcome measures were reassessed post intervention.

Results: This study demonstrated that all outcome measures showed statistical and clinical significance in both groups ($p<0.05$). The fear of falling and balance were found to have improved more in Group A (the intervention group) than in Group B, both statistically and clinically.

Conclusion: The study concluded that Brain gym in adjunct to balance exercise was more effective in improving fear of fall and balance clinically and statistically.

KEY WORDS: Fear of fall, Brain Gym, Parkinsonism, Parkinson's disease, Balance, MINIBESTest, Fall Efficacy Scale-International assessed.

Address for correspondence: Dr. Sabah Thaver, Assistant professor Department of Physiotherapy, Sunandan Divatia School of Science, SVKM'S NMIMS (Deemed to Be) UNIVERSITY, Vile Parle, Mumbai, Maharashtra, India. **E-Mail:** sabah.thaver@nmims.edu

Access this Article online	Journal Information
Quick Response code	**International Journal of Physiotherapy and Research** ISSN (E) 2321-1822 | ISSN (P) 2321-8975 **https://www.ijmhr.org/ijpr.html** **DOI-Prefix:** https://dx.doi.org/10.16965/ijpr
DOI: 10.16965/ijpr.2024.126	**Article Information**
Received: 29 Jul 2024 Peer Review: 31 Jul 2024 Revised: 05 Aug 2024	Accepted: 20 Aug 2024 Published (O): 30 Aug 2024 Published (P): 30 Aug 2024

INTRODUCTION

Parkinsonism is a clinical syndrome, which is characterized by bradykinesia, rigidity, rest tremor, and postural instability. Idiopathic Parkinson disease (PD) is the most common cause of this syndrome, though there are several other important etiologies that must be considered [1]. Parkinson's disease is a progressive disorder of the central nervous system with both motor and non-motor symptoms that particularly affects movement [2].

Approximately 60-80% of individuals with PD experience at least one fall each year [2] and approximately 60% of Parkinson's patients had experienced at least one fall in the previous twelve months [3].

This is a significantly higher prevalence compared to the general elderly population, where the annual fall rate is around 30%[4]. Moreover, as the disease progresses, the risk of falls in PD patients increases, with individuals in advanced stages being twice as likely to experience falls as those in the early stages [3].

Factors that lead to falls in Parkinson's include bradykinesia, postural instability, gait disturbances, freezing of gait, and cognitive impairments [5,6]. FOF is a predictor of future falls and near falls already in mild PD and is negatively associated with participation and health-related as well as overall quality of life. Studies that used multivariable regression analyses to identify explanatory factors of FOF have shown that PD-related disabilities such as walking difficulties, need for help in activities of daily living, motor symptoms, orthostatism, poor functional balance, and fatigue are significantly associated with FOF in people with PD [7].

Brain Gym exercises are a series of simple and enjoyable movements designed to enhance learning and brain function. Originally developed to support educational development, these exercises have shown promise in improving physical coordination, mental acuity, and overall well-being. They consists of integrated cross-lateral, balance requiring movements that mechanically activates both hemispheres of the brain via motor and sensory cortex, stimulates the vestibular system (balance) for equilibrium and decrease the flight or fight mechanism [8].

Brain Gym works on the following principles: [8]

1. Laterality – thinking and sidedness, connect the left to the right hemispheres.

2. Centering- feeling and core postural muscles re-establish the neural networks between body and CNS.

3. Focus – works on the attentional system and increases sensory awareness.

Brain gym exercises, involve activities designed to stimulate various cognitive functions, including memory, attention, and executive functions. Engaging in such activities can potentially foster a sense of continuous learning. Encouraging patients with Parkinson's to participate in brain gym exercises can promote an ongoing commitment to cognitive well-being, developing a positive mindset and potentially reducing the fear of falls. While brain gym exercises may not directly address the motor symptoms of Parkinson's disease, their potential benefits in enhancing cognitive function, reducing anxiety, and promoting adaptability make them a valuable complement to a comprehensive treatment plan for managing the fear of falls in Parkinson's patients. Hence this study was conducted to assess the effects of Brain Gym exercises on balance and fear of fall in patients with parkinsons so that it can be considered as part of a broader approach that includes physical therapy, medication management, and environmental modifications.

AIM: To determine the effect of brain gym exercise in addition to balance exercises versus

balance exercises on fear of fall and balance in patients with parkinsonism

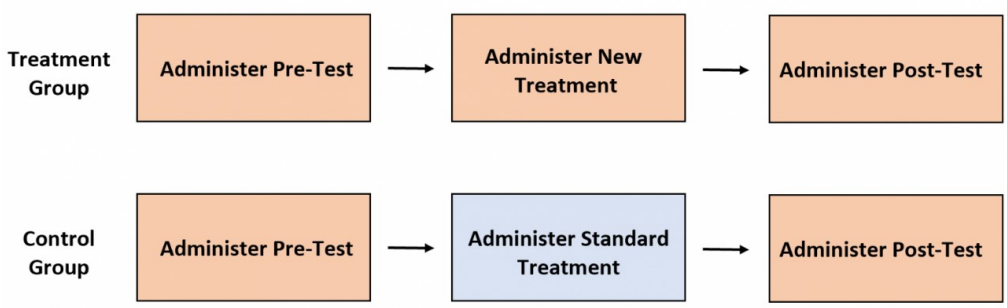
OBJECTIVES:

· To evaluate the effect of balance exercises on fear of fall and balance on patients with Parkinson's.

· To evaluate the effect of Brain Gym Exercises in adjunct to balance exercises on patients with Parkinson's.

· To compare both the group

METHODOLOGY



Study Design: Interventional Study

Study Type: Comparative Study

Study Site: Physiotherapy OPD, Nanavati Max Superspeciality Hospital

Sample Calculation: 50 (25 in each group)

Sampling Method: Convenience sampling (divided into groups using Odd- Even method)

Study Population: Subjects with Parkinsonism, diagnosed by a neurologist.

Inclusion Criteria:

· Subjects diagnosed with Parkinson's and with a clinical score up to 4 on Modified Hoehn and Yahr scale**.**

Exclusion Criteria

· Individuals with any other medical or recent surgical history which may prevent participation in study

· Individuals with vision or auditory disorders.

· Patients with cognitive challenges example: PD associated dementia.

Outcome Measures:

Mini-BESTest: To assess balance, taken at baseline and post intervention

Falls Efficacy Scale International: To assess fear of falls, taken at baseline and post intervention.

Procedure: Ethical Approval was taken from the Institutional Ethical Board at Nanvati Max Hospital. CTRI registration was completed. Subjects were screened and selcetd for the study and written informed consents were taken prior to commencement of treatment. Subjects were randomly divided using odd-even method (odd subjects in Group A – Intervention and Group B - Conventional). Intervention of 12 sessions over 4 weeks (3 sessions/ week) was given. Outcome measures were assessed pre and post intervention and data analysis was done.

Protocol (12 sessions)

Group A – Balance Exercises + Brain Gym Exercises.

Group B – Balance Exercises

Brain Gym Exercises

E –ENERGY: Sipping water

C –CLEAR: Brain Button

A-ACTIVE: Cross Crawl

P-POSITIVE: Hook ups

ECAP followed by activities in Brain gym + Balance exercises.

Lengthening Activities include rebuilding the neural pathways that were already known to the CNS based reduction of the increased postural tone / guarded postures. During the period of stress, the adrenaline levels rise, thus hampering the signals travelling across the central nervous system. The Energy Exercisers and Deepening Attitudes stimulate the parasympathetic system and thereby decrease the adrenaline levels. Midline Movements are based on integrating two sides of the body, binaural hearing and binocular vision, [9]

Balance Protocol: Horak's protocol was used for balance exercises in this study [10] Individuals were asked to rate each of the exercise at the end of the session using a ten-part Likert scale (10 being the greatest level of challenge and 1 being no challenge). Exercise levels were tailored to each individual and will be progressed to increase challenge level when perceived challenge to balance is <7. Initially variable surface conditions and later exercise with eyes closed were performed

Table 1: Brain Gym Protocol

Lengthening Activities	**The Owl**	Grasp the top of the shoulder with its opposite hand and squeeze themuscles firmly. Slowly turn the head to look back over that shoulder. Exhale fully and make a ''whoo'' sound and draw both shoulder's back, opening the chest. Continue to squeeze the shoulder and turn the head to look over the othershoulder, hooting and open the chest again. ''hoot'' again, drop the chin to the chest, allowing muscles to relax.
	The Gravity Glider	Sit up comfortably on the edge of a sturdy chair, extending both the legs in front and let the head hang freely. Let gravity take over. The arms glide down with exhalation and up with inhalation. Do this again, leaning slightly to the left of the centre and then slightly to the right. Cross the feet the other way and repeat the same sequence.
Energy Excersiser	**Brain Button**	Make a U shape with one hand, placing the thumb and index finger in the depressions under the collar bones and either side of the sternum, placing the other hand on the navel Rub the button for about 20-30 seconds. Thelower hand remains on the navel as the eyes track along the horizontal line fromleft to right.
	Positive Hook Ups	Part one: cross one ankle over the other either right or left anklecan be on top. Extend the arms in front and cross one wrist over the other; interlace fingers and draw clasped hands up to the chest. Continue slow breathing Part two: uncross the arms and legs and put the fingertips together infront of the chest, continuing to breathe slowly.
	Earth Button	Place two fingers on the lower lip and rest the palm of the otherhand on the navel, fingertips pointing down along the midline. Look down, thenlet the eyes track a vertical line.
Midline Movements	**Cross Crawls**	cross the body's midline and alternately move one arm and its opposite leg, the other arm and its opposite leg. Touch the elbow to the knee.
	Lazy 8s	Extend one arm straight out in front, with the thumb pointing toward the ceiling. In the air, smoothly and slowly trace the shape of a large figure 8. Focus the eyes on the thumb, keeping the head upright, facing forward and moving only slightly. Start tracing the 8 by beginning at eye level. Move the arm up and over to the left, around and back to the center, then to the right and into the center.
	Alphabet 8s	Paper pencil activity; Start the activity by drawing a lazy 8. Then start drawing letters of the alphabet, observing how the 'a a' begins on the midline with a circle, moving up and around to the left, then up again and down. Perform for other letters.
	The Elephant	place the left ear on the left shoulder and extend the left arm like an elephant's trunk and draw the infinity sign in the air, move the body along with the sign and track it with the eyes.
	Belly Breathing	While breathing deeply, relax the shoulders and drop the head forward. Track with eyes while slowly and quickly rolling the head from side to side.
	Energizer	Sit in a chair at a desk or table with the feet flat and shoulder- width apart. Place the hands on the table aligned in line with the shoulders, fingers pointing slightly inwards and rest the forehead between them. Press hands and forearms down, slowly inhale and raise the head forehead first, followed by sternum/Chest bone and upper back, keeping the shoulder and upper body relaxed. Track with eyes with the movement.
	Neck Roll	While breathing deeply, relax the shoulders and drop the head forward. Track with eyes while slowly and quickly rolling the head from side to side.

Table 2: Balance Protocol.

Bio mechanical constrains	Stability limits, Verticality	Anticipatory Postural Adjustments	Postural Adjustments	Sensory Orientation	Stability in Gait
Calf Raises	Functional reach forward	Step ups	Standing on foam	Squats Foam	Gait at varying speed with auditory cueing
Calf stretch	Functional reach lateral	Sit to stand / Squats	Perturbations on stable and unstable surface	Standing on incline	Gait with dual task conditions
Standing hip abduction	Reaching Overhead	Lunges	Ball toss		Gait with head turns ,starts,stopand quick turns
Push ups or planks		Single limb stance with reaching	Standing hip abduction and flexion		Walking backwards

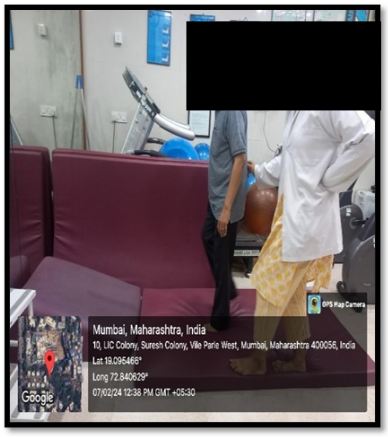


Fig.1: Walking On Foam Surface

Fig. 2: Calf Raises

Fig. 3: Lunges.

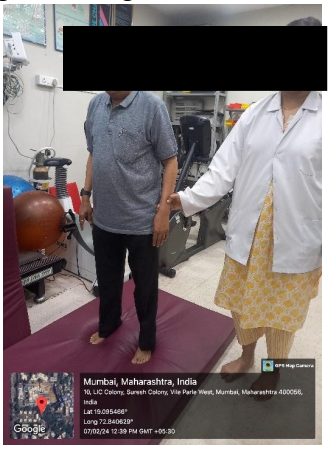


Fig. 4: Hip Abduction And Weight Bearing

Fig. 5: Brain Button.

Fig. 6: The Owl

Fig. 7: Positive Points

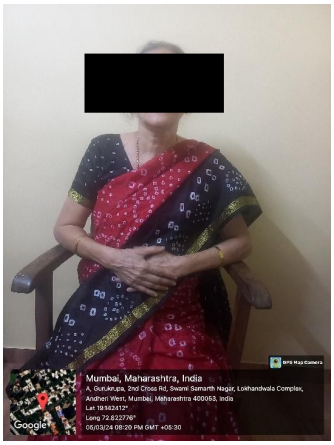


Fig. 8: Belly Breathing

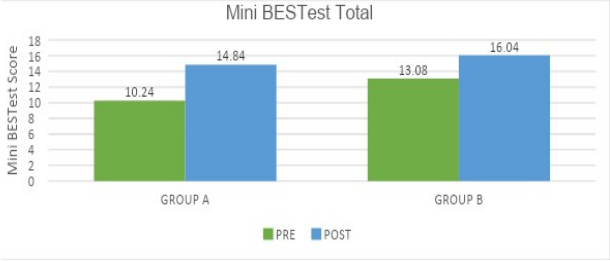
RESULTS

The data analysis was done using the Statistical Package for Social Science version 29 (SPSS-29). The intergroup data was analysed using a 'paired t-test' for changes in post-intervention value from pre-intervention ones. The difference between the two groups, the inter- group data, was analysed using an independent t-test.

The following table shows the baseline data of the subjects analysed for the study:

Table 3: Demographic Data.

	Group A	Group B
Gender (M:F)	22:3	20:05
Age	65.22±9.72	67.72±6.97

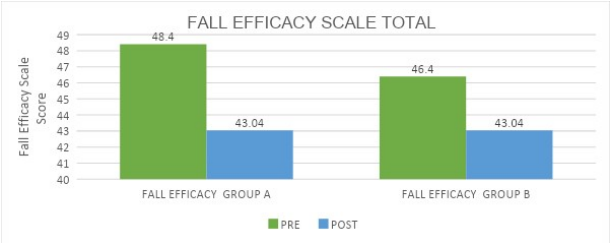


Graph 1: Mini BESTest Total.

Table 4: Mini BESTest Total.

Mini BESTest	PRE	POST	p-value
Group A	10.24±4.918	14.84±4.741	<0.001
Group B	13.08±2.827	16.04±2.776	<0.001

There was a clinical and statistical change observed in the Mini BESTest of both groups individually. The intra group p value obtained was <0.001 (i.e. p<0.05). However, while there was a clinical difference noted in the inter group values, the same wasn't reflected statistically as the p value obtained was p=0.28 (i.e. p>0.05)



Graph 2: Fall Efficacy Scale Total

Table 5: Fall Efficacy Scale Total.

FALL EFFICACY SCALE	PRE	POST	p-value
Group A	48.40±9.823	43.04± 10.597	<0.001
Group B	46.40± 4.682	43.40 ± 4.262	<0.001

There was a clinical and statistical change observed in the Fall Efficacy Scale of both groups individually. The intra group p value obtained was <0.001 (i.e. p<0.05). However while there was a clinical difference noted in the inter group values, the same wasn't reflected statistically as the p value obtained was p=0.81(i.e p>0.05)

DISCUSSION

This study discusses the effects of Brain Gym and Balance Exercise on balance and fear of fall in patient. A set protocol was curated based the difficulties faced by the individual which restricted their mobility on. The goal of these exercises was to improve their balance and reducing fear of fall. Patient was made to do exercise thrice a week for 4 weeks (12 sessions)

MINI – BEST and PARKINSONISM: The following study used Horak's protocol to impart balance training in patients with parkinsonism. The entire protocol includes six components [10].

Horak's theoretical balance framework focuses on all the various 6 components which intervene to maintain balance in the individual where strengthening, range of motion, anticipatory and reactive balance activities, altering sensory input, and gait training.

Exercise regimens were customised for each person and increased in difficulty when the perceived difficulty of balancing was less than seven.

Overall the balance protocol addresses multiple facets of balance impairments in Parkinson's disease, providing a comprehensive approach to rehabilitation that targets specific deficits while considering the individual needs and limitations of each patient. By addressing these key components, patients can experience improvements in balance, mobility, and overall quality of life.

Clinically Group A performed better, it received the brain gym in exercises in addition to the balance protocol.

The original 26 Brain Gym movements—sometimes referred to as the 26—are the exercises that make up the Brain Gym. The holistic approach of brain gym exercises, engaging cognitive, sensory, and motor systems, holds

promise in contributing to balance improvement in Parkinson's patients by promoting neuroplasticity, enhancing coordination and proprioception, engaging cognitive functions, reducing stress, and facilitating whole-body integration.

FES-I AND PARKISONISM: Parkinsonian patients experience a complex and extremely unsettling fear of falling, which affects their daily lives. Its primary cause is the progressive loss of balance and motor control, which are two of Parkinson's disease's most common symptoms.

This fear embraces the deep psychological and emotional implications that falling carries, in addition to being a response to the physical act of falling itself. Positive improvements with respect to anxiety and stress that led to reduced fear of falls in both the groups. Group A showed further improvement because it received brain gym exercises in addition to the balance protocol.

Brain Gym exercises can significantly help improve balance and reduce the fear of falls in Parkinson's patients through various detailed mechanisms:

Enhancing Coordination and Motor Skills: Brain Gym exercises involve coordinated movements that engage both sides of the body, such as cross-crawls (touching the right hand to the left knee and vice versa). These exercises stimulate the brain to improve motor planning and execution, essential for maintaining balance.

Increasing Body Awareness and Proprioception: Exercises like the "Balance Buttons" and "Calf Pump" focus on enhancing proprioception, which is the sense of the relative position of body parts. These movements train the brain to better interpret sensory information from muscles and joints.

Strengthening Neural Connections: Brain Gym exercises stimulate various parts of the brain, promoting neuroplasticity (the brain's ability to form new neural connections). Activities like "Brain Buttons" activate areas responsible for coordination and balance.

Improving Flexibility and Range of Motion: Exercises such as "Lazy 8s" and "The Elephant" promote gentle stretching and movement of different body parts. These movements can help maintain and improve the flexibility and range of motion in joints and muscles.

Reducing Anxiety and Fear of Falling: Brain Gym exercises incorporate elements of relaxation and mindfulness, which can help reduce anxiety. Activities like "Positive Points" focus on calming the mind and relieving stress.

Engaging Cognitive Functions: Many Brain Gym exercises require simultaneous physical and cognitive tasks, such as tracking movements with the eyes or remembering sequences. This dual engagement keeps the brain active and improves cognitive functions related to movement and balance.

The 'Hypothalamus-Pituitary- Adrenal axis is a crucial neuroendocrine system that plays a role in controlling the body's reaction to stress and preserving different physiological processes.

Overall neurodegenerative brain diseases are often linked to HPA-axis dysregulation. This dysregulation may impact the progression of the disease, since stress seems to trigger or exacerbate motor symptoms and behaviour disorders such as impulse control disorders. It is believed that chronic stress may be unfavourable to neurons, facilitating neuronal degeneration.

Brain Gym Exercises of Energy Exercisers and The Deepening Attitudes stimulates the semi-circular canals through electrical impulses generated and therefore activates the Brain Stem Reticular Activating System which screens the irrelevant and distracting stressors and creates a wakeful awareness and relaxed state of mind (Alpha state), thus reducing the stress and anxiety, facilitating focus, attention and concentration in these subjects.

CONCLUSION

Therefore, this study concludes that brain gym exercises along with balance training should be included in the rehabilitation protocol of patients with Parkinsonism in order to reduce their fear of fall which helps in improving balance.

Limitation: Patients with higher Hoen and Yahr

scale proved challenging to treat in terms of: Adherence to homework, Progression was slower or did not happen.

Future Scope of Study: Having a long term follow up to see if the effects of Brain Gym are sustained.

ABBREVATIONS

PD - Parkinson's Disease
ADL - Activity of Daily Living
ANpc - Substantia Nigra pars compacta
ASyn - Alpha Synuclein
QOL - Quality of Life
DALY - Disability Adjusted Life Years
FOF - Fear of Fall

Authors Contribution

Saylee Phatak: Contributed towards selection of topic, Research Process, Research, Design, Data Collection, Manuscript Drafting.

Sabah Thaver: Research Design, Statistical Research Analysis, Discussion and Editing.

Ali Irani: Research Design, Statistical Research Analysis, Discussion and Editing.

Conflicts of interest: None

REFERENCES

[1]. Keener AM, Bordelon YM. Parkinsonism. Semin Neurol. 2016 Aug;36(4):330-4. https://doi.org/10.1055/s-0036-1585097 PMid:27643900

[2]. Paul, S. S., Canning, C. G., & Sherrington, C. The relative contribution of physical and cognitive fall risk factors in people with Parkinson's disease: a large prospective cohort study. Journal of Neurology, Neurosurgery & Psychiatry, 2018;89 (11):1140-1147.

[3]. ickering, R. M., Grimbergen, Y. A., Rigney, U., Ashburn, A., Mazibrada, G., Wood, B., & Rochester, L. A meta-analysis of six prospective studies of falling in Parkinson's disease. Movement Disorders, 2007;22(13):1892-1900. https://doi.org/10.1002/mds.21598 PMid:17588236

[4]. Allen, N. E., Schwarzel, A. K., Canning, C. G., & Sherrington, C. Reduced muscle power is associated with slower walking velocity and falls in people with Parkinson's disease. Parkinsonism & Related Disorders, 2013;19(8):839-843.

[5]. Balash, Y., Peretz, C., Leibovich, G., Herman, T., & Hausdorff, J. M. Falls in outpatients with Parkinson's disease: frequency, impact and identifying factors. Journal of Neurology, 2005;252(11):1310-1315. https://doi.org/10.1007/s00415-005-0855-3 PMid:15895303

[6]. Yarnall, A. J., Breen, D. P., Duncan, G. W., Khoo, T. K., Coleman, S. Y., Firbank, M. J., ... & Burn, D. J. Characterizing mild cognitive impairment in incident Parkinson disease: the ICICLE-PD study. Neurology, 2014;82(4):308-316. https://doi.org/10.1212/WNL.0000000000000066 PMid:24363137 PMCid:PMC3929202

[7]. Jonasson, S. B., Nilsson, M. H., Lexell, J., & Carlsson, G. Experiences of fear of falling in persons with Parkinson's disease - a qualitative study. BMC geriatrics, 2018;18(1):44. https://doi.org/10.1186/s12877-018-0735-1 PMid:29409443 PMCid:PMC5801775

[8]. Siroya, N. V. V., Naqvi, N. W. M., & Kulkarni, N. C. A. Importance of Brain gym as exercise in physiotherapy and rehabilitation. International Journal of Research in Pharmaceutical Sciences, 2020;11(SPL4):1386-1389. https://doi.org/10.26452/ijrps.v11iSPL4.4310

[9]. Panse R, Deshpande M, Yeole U et.al. Effect of brain gym® exercises on balance and risk of fall in patients with diabetic neuropathy. International Journal of Science & Healthcare Research. 2018;3(4):257-262.

[10]. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? Age Ageing. 2006; 35(Suppl 2):ii7-ii11. https://doi.org/10.1093/ageing/afl077 PMid:16926210

How to cite this article: Saylee Pravin Phatak, Sabah Thaver, Ali Irani. Effect of Brain Gym Exercise in Addition to Balance Exercises Versus Balance Exercises on Fear of Fall and Balance in Patients with Parkinsonism. Int J Physiother Res 2024;12(4):4768-4775. **DOI:** 10.16965/ijpr.2024.126