

## COMPARING THE EFFECTIVENESS OF OTAGO EXERCISE WITH REACTIVE BALANCE TRAINING VERSUS OTAGO EXERCISE AMONG THE ELDERLY POPULATION TO PREVENT FALLS

*R. Radhakrishnan<sup>1</sup> & V. Priyadharshini<sup>2</sup>*

<sup>1</sup>Professor, Tagore College of Physiotherapy, (Affiliated to the Tamilnadu Dr. MGR Medical University)

<sup>2</sup>Physio Intern, Tagore College of Physiotherapy, (Affiliated to the Tamilnadu Dr. MGR Medical University)

**Received: 02 May 2024**

**Accepted: 07 May 2024**

**Published: 08 May 2024**

### **ABSTRACT**

#### **BACKGROUND OF THE STUDY**

*A fall is defined as an incident that results in a person coming to rest accidentally on the ground or floor or other lower level. Recent evidence has suggested that a multi- component exercise regimen focusing on flexibility, strength, balance, and endurance can effectively improve balance, mobility, and physical performance as well as reduce the incidence of falls and fall-related injuries in community-dwelling older adults. The Otago Exercise Program encompassed all the aforementioned aspects and was developed for community-dwelling older adults aged more than 65 years old. Perturbation-based Balance Training is a task-specific intervention that aims to improve reactive balance control (i.e., rapid reactions to instability) after destabilizing perturbations in a safe and controlled environment. Hence, the aim of the study is to compare Otago Exercise with Reactive Balance Training and Otago Exercise only for fall prevention among the elderly population.*

#### **MATERIALS AND METHODOLOGY**

*The study was conducted as a comparative study for a total period of four weeks, which includes 12 sessions. In this study, Group A included 15 community-dwelling older adults who were trained using Otago Exercise with Reactive Balance Training and Group B included 15 community-dwelling older adults who were trained using Otago exercise only. The pre and post-test values of the Berg Balance Scale, Timed Up-and-go test, and 30-second sit-to-stand test were taken for analysis.*

#### **RESULT**

*P-value for Group A is  $< 0.0001$  and of Group B is  $< 0.0001$ . However, based on the mean difference value of Group A and Group B it was shown that Group A is effective and highly statistically significant.*

#### **CONCLUSION**

*This study concludes that Otago Exercise with Reactive Balance Training is more effective in preventing falls compared to Otago Exercise only.*

**KEYWORDS:** *Elderly falls, Otago Exercise, Reactive balance, Perturbation-based Balance Training, Berg Balance Scale, Timed Up and Go test, 30-second sit-to-stand test.*

## INTRODUCTION

Falls are a major public health issue among older adults worldwide. Over one-third of the community-dwelling older adults and half of older adults living in the institutions fall annually [5]. Susceptibility to falls results from an interaction of multiple factors: Reduced efficacy of postural responses; diminished sensory acuity; impaired musculoskeletal, neuromuscular, and cardiopulmonary systems; deconditioning associated with inactivity; depression and low balance self-efficacy; polypharmacy; and a host of environmental factors. Fall risk factors can be classified as intrinsic and extrinsic. Intrinsic risk factors are traits of an individual that increase their risk of falling; these are most important amongst the oldest age group and can be related to neurosensory impairment, certain drugs, or the presence of diseases associated with an increased risk of falling (e.g., Parkinson's, stroke, osteoarthritis or diabetes). The risk of having a fall or recurrent falls increases with the number of associated intrinsic risk factors. Extrinsic causes are social and physical factors that relate to an external environment, unrelated to disease or drug use, slip-on ice, for example. If both intrinsic and extrinsic factors are present, falls are classified as combined [5]. In these, the modifiable risk factors for falls include muscle weakness, gait and balance problems, poor vision, psychoactive medications, and home hazards [10].

Balance is defined as the ability to maintain the projection of the body's center of mass within the limits of the base of support, as in the sitting or standing position, or in transit to establish a new base of support, as during walking [5]. Balance is necessary for an individual to maintain posture, respond to voluntary movements, and react to external perturbations. Balance problems are a major cause of falls and have been shown to be associated with increased fear of falling and decreased balance confidence. Researchers have reported that balance training improves lower extremity muscle function and performance-based exercise aimed at improving static and dynamic balance such as one-leg standing, tandem stance, reaching, and walking sideways.

The Otago exercise program, which consists of muscle-strengthening exercises, balance training, and walking [15], was developed and tested by the New Zealand Falls Prevention Research Group in New Zealand to reduce falls in older persons [32]. Otago Exercise Program has been proven to effectively improve the cognitive function, balance ability, lower limb muscle strength, and functional physical fitness of older adults, prevent falls in older adults, accelerate physical function recovery, and reduce economic costs because its training content emphasizes strength and balance exercises more.

Reactive balance training (RBT) is a type of exercise aimed at improving the control of fall prevention reactions when one loses their balance. Systematic reviews suggest reactive balance training may reduce fall rates by 46% - 48% [40]. Perturbation-based balance training is a task-specific intervention that aims to improve reactive balance control (i.e., rapid reactions to instability) after destabilizing perturbations in a safe and controlled environment.

## METHODOLOGY

This study was carried out among 30 community dwelling elderly people for 4 weeks who were selected based on the inclusion and exclusion criteria using simple random sampling technique. In this study, subjects aged between 65-80 years, both males and females and elderly people who perform physical activity at least 15 mins a day were selected. Parameters used in this study are the Berg balance scale, Timed up and go test, and 30 sec sit to stand test. The 30-community dwelling older adults were divided into two groups, namely group A (n=15) and group B (n=15). The Otago exercise with Reactive balance training were given for group A and Otago exercise only for group B, the repetitions were progressed every week.

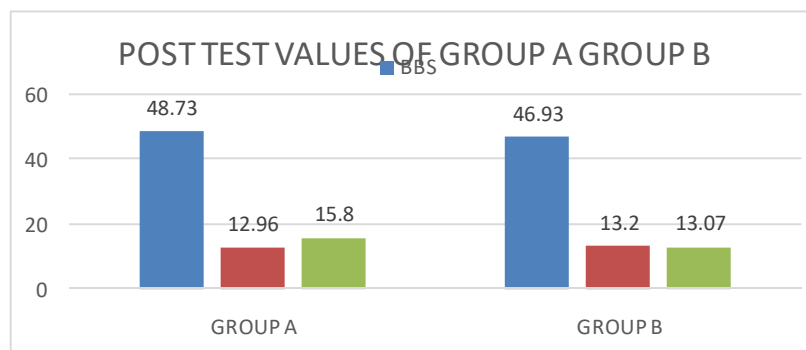
**RESULT**

**Table 1: GROUP A**

VARIABLES	MEAN		SD		T-VALUE	P-VALUE
	PRE	POST	PRE	POST		
1. Berg Balance Scale	37.33	48.73	3.27	2.02	27.687	<0.0001
2. Timed Up and Go Test	13.78	12.96	0.177	0.203	27.531	<0.0001
3. 30-second Sit-to- Stand Test	10	15.80	1PRE.00	1.15	33.223	<0.0001

**Table 1: GROUP B**

VARIABLES	MEAN		SD		T-VALUE	P-VALUE
	PRE	POST	PRE	POST		
1. Berg Balance Scale	39.20	46.93	2.46	1.39	17.516	<0.0001
2. Timed Up and Go Test	13.82	13.20	0.209	0.204	17.498	<0.0001
3. 30-second Sit-to- Stand Test	9.87	13.07	1.06	0.80	18.330	<0.0001



**Figure 1**

**DISCUSSION**

The pre-test values for the Berg Balance Scale, Timed up and go test, and 30-second sit- to-stand test were taken before the intervention for both the groups, and post-test values for the Berg Balance Scale, Timed up and go test, and 30-second sit-to-stand test was taken after four weeks for both the Group A and Group B. The pre-test and post-test values were taken for analysis using paired t-tests. Based on the results received, both the groups show significant improvement in balance and leg muscle strength and thus prevents falls. The result shows that the Combination of Otago Exercise with Reactive Balance Training shows more improvement in leg muscle strength and balance compared to the group with only Otago exercise.

**CONCLUSION**

Therefore, according to the results obtained it is determined that the group with Otago exercise with Reactive balance training (Group A) has significantly shown better improvement in balance and lower limb muscle strength than the group with Otago Exercise (Group B). Therefore, our hypothesis (H1) was supported by the current result obtained.

So, by this study, I conclude that the Otago Exercise with Reactive Balance Training shows more effect in the improvement of balance and leg muscle strength, thus preventing falls.

## REFERENCES

1. Mgbeojedo UG, Akosile CO, Okoye EC, Ani KU, Ekechukwu EN, Okezue OC, John JN, Nwobodo N. *Effects of Otago Exercise Program on Physical and Psychosocial Functions Among Community-Dwelling and Institutionalized Older Adults: A Scoping Review. Inquiry.* 2023 Jan-Dec; 60:469580231165858. doi: 10.1177/00469580231165858. PMID: 37039392; PMCID: PMC10107987.
2. Pittaras, Georgios & Iakovidis, Paris & Sindos, Campus & Thessaloniki, Greece & Kasimis, & Thessaloniki, Greece & Antonis, Fetlis & Pt, & Lytras, Dimitrios & Papatheodorou, Evangelia & Kasimis, Konstantinos & Fetlis, Antonis. (2023). *The effect of strengthening and balance programs on preventing falls in the elderly: A systematic review. International Journal of Advanced Research in Medicine.* 5. 20-24. 10.22271/27069567.2023.v5.i1a.432.
3. Yang Y, Wang K, Liu H, Qu J, Wang Y, Chen P, Zhang T, Luo J. *The impact of Otago exercise program on the prevention of falls in older adult: A systematic review. Front Public Health.* 2022 Oct 20;10:953593. doi: 10.3389/fpubh.2022.953593. PMID: 36339194; PMCID: PMC9631473.
4. Naseer, B. ., Dastgir, H., Sadiq, A., Salik, S., Abid, N., & Tayyab, M. . (2022).
5. *Factors Associated with Risk of Fall in Elderly Population: Risk of Fall in Elderly Population. The Healer Journal of Physiotherapy and Rehabilitation Sciences,* 2(3), 221–231. <https://doi.org/10.55735/hjprs.v2i3.84>.
6. Chiu HL, Yeh TT, Lo YT, Liang PJ, Lee SC. *The effects of the Otago Exercise Programme on actual and perceived balance in older adults: A meta-analysis. PLoS One.* 2021 Aug 6;16(8):e0255780. doi: 10.1371/journal.pone.0255780. PMID: 34358276; PMCID: PMC8345836.
7. Gerards MHG, Marcellis RGJ, Poeze M, Lenssen AF, Meijer K, de Bie RA. *Perturbation-based balance training to improve balance control and reduce falls in older adults - study protocol for a randomized controlled trial. BMC Geriatr.* 2021 Jan 6;21(1):9. doi: 10.1186/s12877-020-01944-7. PMID: 33407204; PMCID: PMC7788687.
8. Kim Y, Vakula MN, Bolton DAE, Dakin CJ, Thompson BJ, Slocum TA, Teramoto M, Bressel E. *Which Exercise Interventions Can Most Effectively Improve Reactive Balance in Older Adults? A Systematic Review and Network Meta-Analysis. Front Aging Neurosci.* 2022 Jan 18;13:764826. doi: 10.3389/fnagi.2021.764826. PMID: 35115917; PMCID: PMC8804322.
9. You, Y. & Shao, M. & Hu, Y. & Zhang, Y. & Wang, G. & Zhu, J.. (2020). *Early Warning Model of Fall Risk for the Elderly Based on Gait Characteristics. Yiyong Shengwu Lixue/Journal of Medical Biomechanics.* 35. 357-363. 10.16156/j.1004- 7220.2020.04.015.
10. Papalia GF, Papalia R, Diaz Balzani LA, Torre G, Zampogna B, Vasta S, Fossati C, Alifano AM, Denaro V. *The Effects of Physical Exercise on Balance and Prevention of Falls in Older People: A Systematic Review and Meta-Analysis. J Clin Med.* 2020 Aug 11;9(8):2595. doi: 10.3390/jcm9082595. PMID: 32796528; PMCID: PMC7466089.

11. Lurie JD, Zagaria AB, Ellis L, Pidgeon D, Gill-Body KM, Burke C, Armbrust K, Cass S, Spratt KF, McDonough CM. Surface Perturbation Training to Prevent Falls in Older Adults: A Highly Pragmatic, Randomized Controlled Trial. *PhysTher.* 2020 Jul 19;100(7):1153-1162. doi: 10.1093/ptj/pzaa023. PMID: 31998949; PMCID: PMC7498164.
12. Allin LJ, Brolinson PG, Beach BM, Kim S, Nussbaum MA, Roberto KA, Madigan ML. Perturbation-based balance training targeting both slip- and trip-induced falls among older adults: a randomized controlled trial. *BMC Geriatr.* 2020 Jun 12;20(1):205. doi: 10.1186/s12877-020-01605-9. PMID: 32532221; PMCID: PMC7291462.
13. Beato M, Dawson N, Svien L, Wharton T. Examining the Effects of an Otago-Based Home Exercise Program on Falls and Fall Risks in an Assisted Living Facility. *J Geriatr Phys Ther.* 2019 Oct/Dec;42(4):224-229. doi: 10.1519/JPT.000000000000190. PMID: 29698252.
14. Ansai JH, Aurichio TR, Gonçalves R, Rebelatto JR. Effects of two physical exercise protocols on physical performance related to falls in the oldest old: A randomized controlled trial. *GeriatrGerontol Int.* 2016 Apr;16(4):492-9. doi: 10.1111/ggi.12497. Epub 2015 Apr 14. PMID: 25868484.
15. Dijkstra BW, Horak FB, Kamsma YP, Peterson DS. Older adults can improve compensatory stepping with repeated postural perturbations. *Front Aging Neurosci.* 2015 Oct 21;7:201. doi: 10.3389/fnagi.2015.00201. PMID: 26539111; PMCID: PMC4612504.
16. Hirase T, Inokuchi S, Matsusaka N, Okita M. Effects of a balance training program using a foam rubber pad in community-based older adults: a randomized controlled trial. *J GeriatrPhysTher.* 2015 Apr-Jun;38(2):62-70. doi: 10.1519/JPT.000000000000023. PMID: 24978931.
17. Pai YC, Bhatt T, Yang F, Wang E. Perturbation training can reduce community-dwelling older adults' annual fall risk: a randomized controlled trial. *J Gerontol A BiolSci Med Sci.* 2014 Dec;69(12):1586-94. doi: 10.1093/gerona/glu087. Epub 2014 Jun 24. PMID: 24966227; PMCID: PMC4296119.
18. Grabiner MD, Donovan S, Bareither ML, Marone JR, Hamstra-Wright K, Gatts S, Troy KL. Trunk kinematics and fall risk of older adults: translating biomechanical results to the clinic. *J ElectromyogrKinesiol.* 2008 Apr;18(2):197-204. doi: 10.1016/j.jelekin.2007.06.009. Epub 2007 Sep 7. PMID: 17826181.
19. Lockhart TE, Smith JL, Woldstad JC. Effects of aging on the biomechanics of slips and falls. *Hum Factors.* 2005 Winter;47(4):708-29. doi: 10.1518/001872005775571014. PMID: 16553061; PMCID: PMC2895260.
20. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exerc Sport.* 1999 Jun;70(2):113-9. doi: 10.1080/02701367.1999.10608028. PMID: 10380242.

22. *Caroline Simpkins, Feng Yang, Muscle power is more important than strength in preventing falls in community-dwelling older adults, Journal of Biomechanics, Volume 134, 2022, 111018, ISSN 0021-9290, <https://doi.org/10.1016/j.jbiomech.2022.111018>.(<https://www.sciencedirect.com/science/article/pii/S0021929022000744>)*
23. *Mansfield A, Aqai A, Danells CJ, Knorr S, Centen A, DePaul VG, Schinkel-Ivy A, Brooks D, Inness EL, Mochizuki G. Does perturbation-based balance training prevent falls among individuals with chronic stroke? A randomized controlled trial. BMJ open. 2018 Aug 1;8(8):e021510. doi: 10.1136/bmjopen-2018-021510*