Advances in Bioresearch
Adv. Biores., Vol 15 (1) January 2024: 165-170

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.15.1.165170

Advances in Bioresearch

ORIGINAL ARTICLE

Exploring the Impact of Balance Enhancing Exercise Program on Balance and Risk of Falls in Elderly Patients with Chronic Musculoskeletal Pain

Hari Babu K V1,, Neeta Vyas2, Ashish Kakkad3,
1 -PhD Scholar, School of Physiotherapy, P P Savani University, Surat, Gujarat, India
2- Supervisor, School of Physiotherapy, P P Savani University, Surat, Gujarat, India
3- Co-Supervisor, School of Physiotherapy, P P Savani University, Surat, Gujarat, India

ABSTRACT
The study investigated the effectiveness of a balance-enhancing exercise program in mitigating balance impairments among elderly individuals with chronic musculoskeletal pain (CMP). Using the Friedman Test for repeated measures, significant improvements were observed in the intervention group's Berg Balance Scale (BBS) scores, with median scores increasing from 38 to 41 over the 6-week period. Similarly, the control group exhibited significant increases in BBS scores from baseline to the 3rd and 6th weeks. Post-hoc pair wise comparisons revealed significant improvements in BBS scores between all time intervals within the intervention group, indicating a robust and sustained effect of the exercise program on balance enhancement. These findings are noteworthy as they demonstrate the program's efficacy in eliciting rapid improvements in balance, particularly during the initial stages of intervention. Such early enhancements are crucial for reducing the risk of falls among elderly individuals with CMP, thereby enhancing their overall safety and quality of life. By elucidating the timing and magnitude of the intervention's effects, this study provides valuable insights for health care practitioners and policymakers aiming to implement evidence-based interventions for CMP management in aging populations. However, further research is warranted to explore the long-term sustainability of these improvements and their broader implications for functional outcomes and fall prevention strategies. Additionally, investigating the program's cost-effectiveness and scalability in real-world settings would be beneficial for informing health care policy and practice. Overall, the study underscores the importance of targeted exercise interventions in addressing the multifaceted challenges posed by CMP in elderly individuals, ultimately contributing to enhanced well-being and quality of life.
Keywords: Balance exercise, Chronic Musculo skeletal Pain, Elderly Population, Risk of fall.

Received 24.09.2023 Revised 01.10.2023 Accepted 08.12.2023

How to cite this article:
Hari Babu K V,, Neeta Vyas, Ashish Kakkad. Exploring the Impact of Balance Enhancing Exercise Program on Balance and Risk of Falls in Elderly Patients with Chronic Musculoskeletal Pain. Adv. Biores., Vol 15 (1) January 2024: 165-170

INTRODUCTION

Chronic musculoskeletal pain (CMP) is a pervasive health concern affecting millions worldwide, with particularly pronounced implications for the aging population. As per estimations by the World Health Organization (WHO), a substantial portion of individuals globally—ranging from 20% to 33%—endure persistent musculoskeletal discomfort, highlighting the urgency of addressing this multifaceted issue. Among the most vulnerable demographics are the elderly, whose advancing age often exacerbates the severity and impact of CMP on their daily lives. (1,2,3)

Against this backdrop, the study titled "A Study to Find the Effect of Balance Enhancing Exercise Program on Balance and Risk of Fall Among Elderly with Chronic Musculoskeletal Pain" seeks to address a critical gap in understanding and intervention. In India, a nation experiencing significant demographic shifts, the aging population is expected to surge, reaching an estimated 198 million by 2030. This demographic transition underscores the pressing need to mitigate the challenges posed by CMP, especially among older individuals who face heightened risks of falls and associated injuries. (4,5)

The repercussions of CMP extend beyond mere physical discomfort, permeating various aspects of individuals' lives, including functional abilities, psychological well-being, and social participation. The WHO's 2015 report underscored the profound implications of musculoskeletal health issues on healthy aging, highlighting them as a significant threat to the well-being of aging populations worldwide. (4,6,7,8)
Central sensitization—a neurological phenomenon intricately linked to the perpetuation of CMP—amplifies pain perception and contributes to heightened sensitivity to stimuli. This condition not only exacerbates pain but also impairs mobility and balance, significantly increasing the risk of falls among the elderly population. (9,10,11)
The study aims to investigate the impact of a balance-enhancing exercise program on both balance and the risk of falls among elderly individuals suffering from chronic musculoskeletal pain. Specifically, the research focuses on evaluating the effects of a sensory motor training-based balance enhancement regimen on balance improvement and fall prevention.

MATERIAL AND METHODS

The study design involves a randomized controlled trial, employing simple random sampling, which is further stratified through computer-generated random sampling. The method of allocation will be executed using the sealed envelope method. The intervention period will span 6 weeks.
The outpatient departments (OPD) of P.P. Savani Heart Institute and Multi-Specialty Hospital in Surat, as well as the OPDs of the P.P. Savani School of Physiotherapy extension in Kosamba and the P.P. Savani School of Physiotherapy at the University Campus, will be involved in this study. The sample size will be determined based on assumptions of a large effect size of 0.8, a power of 0.9, and a Type I error of $\acute{\alpha}$ = 0.05, with balance as the primary outcome measure. Taking into account a 15% dropout estimation, the total sample size will be 80, with 40 participants in each group.
The inclusion criteria encompass patients experiencing chronic musculoskeletal (MSK) pain persisting for a consecutive 3-month period, community-dwelling elderly individuals aged between 60-70 years, who have not undergone balance or gait training within the past 6 months, with a Numeric Pain Rating Scale (NPRS) score falling between 4 to 7 on a 0 to 10 (11-point scale), and possessing intact cognitive function, as indicated by a Mini-Mental State Examination score greater than 24. Conversely, exclusion criteria involve participants with dementia or known cognitive impairment, MSK pain attributed to inflammatory rheumatic disease, severe or uncontrolled heart disease, recent major joint replacement or spinal surgery within the last 6 months, a history of stroke or major surgery within the same period, neurological or musculoskeletal conditions limiting mobility, symptomatic cardiovascular disease, and patients with comorbidities likely to influence safety or balance. Berg balance score (BBS) was used as an outcome measure.
Procedure: After Random allocation and baseline assessment, Standard treatment protocol from practice guideline will be administered to control group and along with standard treatment protocol sensorimotor training will be administered twice a week for Six weeks in total 12 training sessions for intervention group in three phases. Sensorimotor training is a special form of proprioceptive and balance exercise that was designed for management of patients with chronic musculoskeletal pain syndromes. It is based on the concept that instead of emphasizing the isolated strength of a group of muscles around a joint, we should realize the importance of the central nervous system in regulating movement in order to reach proper firing patterns for maintaining joint stability(13)

Treatment Protocol for Control Group:

Hydrocollateral packs, isometric quadriceps exercises, strengthening of the knee and hip muscles, calf and hamstring stretches, short arc quadriceps movements, and a home exercise regimen are all part of the treatment for Osteoarthritis knee. Hydrocollateral packs, thoracolumbar fascia stretching, core stability exercises, stretching and strengthening, and a home exercise regimen were administered for Non-specific low back pain. Treatment for Cervical spondylosis involves hydro collateral packs, strengthening posterior neck muscles, soft tissue manipulation, and home exercise Programme. Treatment for Periarthritis shoulder includes pulley exercises, pendular exercises, capsular stretching and strengthening, hydro collateral packs, and home exercise Programme.

Treatment Protocol for Intervention group :

The three stages of the sensorimotor training program are static, dynamic, and functional, and they are combined with usual treatment. Exercises are performed three to five times during each session, with sufficient rest intervals. Exercises go from easy to hard gradually, following a set routine. Static balance exercises are done for the first two weeks, moving from standing up straight on a hard surface to balancing on one leg on a spongy surface. The next two weeks will be dedicated to introducing dynamic exercises such as forward stepping lunges and T-band kicks. The last two weeks are devoted to functional

training, which includes a thorough program to increase strength, mobility, and balance. Included are toe and heel skipping variations, squatting against and away from walls, one-leg squats, and walking exercises on foam or solid surfaces. In addition, wobble board balancing exercises.

Table 1: Procedure

Group A (Control group)	Group B (Intervention Group)
Pre assessment : Balance , and Risk of fall	Pre assessment : Balance , and Risk of fall
Conventional exercises	Conventional exercises and Balance enhancing exercise Program (Sensory motor training)
Post assessment : Balance , and Risk of fall assessment at the end of 3rd week and 6th week.	Post assessment : Balance , and Risk of fall at the end of 3rd week and 6th week.

RESULT

This randomized control trial was conducted in 80 patients having chronic musculoskeletal pain who were divided in 2 groups: 40 patients in intervention group and 40 patients in control group.

Within the group differences was analyzed in intervention and control group to assess the effect of training produced by conventional exercises and/or sensory motor training using Friedman Test which is a non-parametric test for repeated measures.

Within the intervention group, median BBS increase from 38 to 39 from baseline to 3rd week and from 39 to 41 from 3rd week to 6th week. This difference was found to be statistically significant at $p<0.001$ (Friedman Test $c2 = 79.51$, $df = 2$, $p < 0.001$).

Within the control group, median BBS increased from 38 to 39 from baseline to 3rd week and from 39 to 40 from 3rd week to 6th week. This difference was found to be statistically significant at $p<0.001$ (Friedman Test $c2 = 79.04$, $df = 2$, $p < 0.001$) (Table 2).

It is important to identify at which time interval, the maximum and most significant effect of the intervention was achieved. Post-hoc pair wise comparisons was done using Dunn-Bonferroni post hoc multiple comparison tests to quantify the effect of intervention on increment in BBS between these time intervals. It was found that increase in BBS between baseline to 3rd week measurement was statistically significant (Test statistics = 1.012, $p<0.001$). The baseline to 6th week difference in intervention group was also found to be statistically significant (Test statistics = 1.988, $p<0.001$). Similarly, during 3rd week to 6th week, the BBS increase was statistically significant at $p<0.001$ (Test statistics = 0.975, $p<0.001$).

Table 2 : Assignment of Patients to Intervention Group and Control Group

Sr. No.	Diagnosis	Intervention Group	Control Group	Total
1	OA Knee	10 (50%)	10 (50%)	20 (25%)
2	Low Backache	10 (50%)	10 (50%)	20 (25%)
3	Cervical Spondylosis	10 (50%)	10 (50%)	20 (25%)
4	Periarthritis of Shoulder	10 (50%)	10 (50%)	20 (25%)
	Total	**40 (50%)**	**40 (50%)**	**80 (100%)**

Table 3: Comparison of Age Distribution of Intervention and Control Group

Sr. No.	Group	Mean Age (±SD) in Years	Median Age (IQR) in Years	Test Statistics and p value
1	Intervention Group (n=40)	64.83 (2.31)	65 (63 - 66.75)	Independent Samples t test = 1.134, df = 78, p=0.26
2	Control Group (n=40)	64.23 (2.42)	64 (63 - 66.5)	

Fig 1: Gender Distribution of Study participants

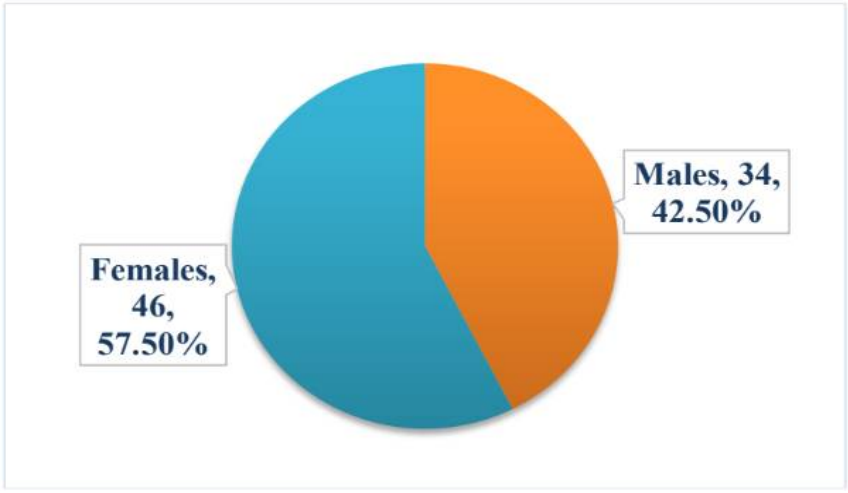
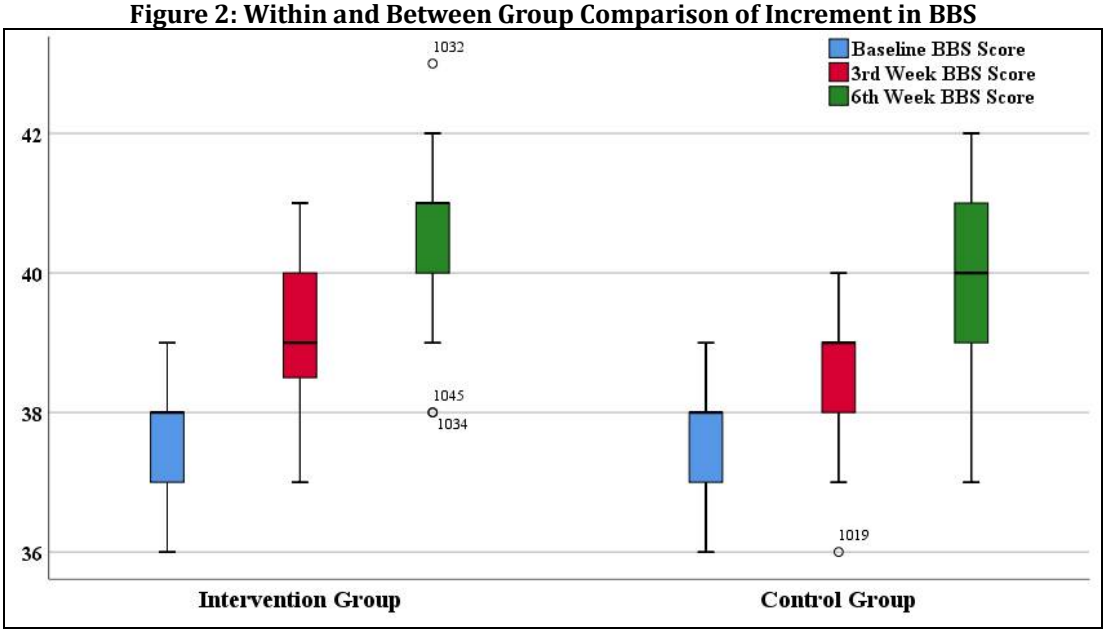


Table 4: Between and Within the Group Differences of BBS

Sr. No.	Variable	Median (IQR)		Between the Group Test Statistics and p value
		Intervention Group (n=40)	Control Group (n=40)	
1	Baseline Berg Balance Scale	38 (37 - 38)	38 (37 - 38)	Mann Whitney Z = 0.367, p = 0.714
2	3rd Week Berg Balance Scale	39 (38.25 - 40)	39 (38 - 39)	Mann Whitney Z = 1.798, p = 0.072
3	6th Week Berg Balance Scale	41 (40 - 41)	40 (39 - 41)	**Mann Whitney Z = 3.38, p = 0.001**
	Within the Group Test Statistics and p value	**Friedman Test $\chi 2$ = 79.51, df = 2, p < 0.001**	**Friedman Test $\chi 2$ = 79.04, df = 2, p < 0.001**	

Figure 2: Within and Between Group Comparison of Increment in BBS



DISCUSSION

The results of the study provide valuable insights into the efficacy of a balance-enhancing exercise program in mitigating balance impairments among elderly individuals with chronic musculoskeletal pain (CMP). The analysis focused on within-group differences, comparing the intervention group, which received the exercise program, with the control group, which did not. The Friedman Test, a non-

parametric test for repeated measures, was utilized to assess the effect of training produced by conventional exercises and/or sensory motor training.

Within the intervention group, a statistically significant improvement in balance was observed over the course of the study period. The median Berg Balance Scale (BBS) scores increased from 38 to 39 between baseline and the 3rd week, and further increased to 41 by the 6th week. These improvements were highly significant, with a p-value of less than 0.001, indicating a robust effect of the intervention on balance enhancement. Similarly, within the control group, significant improvements in BBS scores were observed from baseline to the 3rd week and from the 3rd week to the 6th week, with p-values less than 0.001.

To further understand the timing and magnitude of the intervention's effect, post-hoc pairwise comparisons were conducted using Dunn-Bonferroni post hoc multiple comparison tests. These analyses revealed that the increase in BBS scores was statistically significant between all time intervals within the intervention group. Specifically, significant improvements were observed from baseline to the 3rd week, from baseline to the 6th week, and from the 3rd week to the 6th week, with p-values less than 0.001 in each case.

The findings suggest that the balance-enhancing exercise program yielded significant improvements in balance among elderly individuals with CMP, with the maximum effect observed between baseline and the 3rd week of the intervention. This early improvement underscores the efficacy of the program in eliciting rapid and meaningful changes in balance, which persisted and further improved over the 6-week duration of the study. (12,13,14,15)

The significance of these findings lies in their potential to inform evidence-based interventions aimed at improving the quality of life and reducing the risk of falls among elderly individuals with CMP. By demonstrating the effectiveness of a targeted exercise program in enhancing balance, this study provides valuable insights for healthcare practitioners and policymakers seeking to address the multifaceted challenges posed by CMP in aging populations. Further research may be warranted to explore the long-term effects and sustainability of such interventions, as well as their broader implications for overall health and well-being.

ETHICS COMMITTEE APPROVAL:

The study obtained ethical clearance from the P P Savani ethical committee prior to recruiting patients.

CONFLICT OF INTEREST : No conflict of interest

ACKNOWLEDGEMENT: I express gratitude to the management of P P Savani University for granting permission to recruit patients and conduct the study in the associated OPDs.

REFERENCES:

1. El-Tallawy SN, Nalamasu R, Salem GI, LeQuang JAK, Pergolizzi JV, Christo PJ. (2021). Management of Musculoskeletal Pain: An Update with Emphasis on Chronic Musculoskeletal Pain. Pain and Therapy. 10(1):181-209.
2. Reid MC, Eccleston C, Pillemer K. (2015). Management of chronic pain in older adults. Bmj. ;350.
3. Organization WH. World report on ageing and health: World Health Organization; 2015.
4. James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet. 392(10159):1789-858.
5. Ministry of Social Justice and Empowerment, Government of India. .2016:http:// www.socialjustice.nic.in/writereaddata/UploadFile/dnpsc.pdf. .
6. Shega JW, Tiedt AD, Grant K, Dale W. (2014) Pain Measurement in the National Social Life, Health, and Aging Project: Presence, Intensity, and Location. The Journals of Gerontology: Series B. 69(Suppl_2):S191-S7.
7. Cai Y, Leveille SG, Hausdorff JM, Bean JF, Manor B, McLean RR, et al. (2021). Chronic Musculoskeletal Pain and Foot Reaction Time in Older Adults. The journal of pain. 22(1):76-85.
8. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH. (2017). Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. The Cochrane database of systematic reviews. 4(4):Cd011279.
9. Arribas-Romano A, Fernández-Carnero J, Molina-Rueda F, Angulo-Diaz-Parreño S, Navarro-Santana MJ. (2020). Efficacy of Physical Therapy on Nociceptive Pain Processing Alterations in Patients with Chronic Musculoskeletal Pain: A Systematic Review and Meta-analysis. Pain Medicine. 21(10):2502-17.
10. Latremoliere A, Woolf CJ. (2009). Central Sensitization: A Generator of Pain Hypersensitivity by Central Neural Plasticity. The Journal of Pain. 10(9):895-926.
11. Phillips K, Clauw DJ. (2011). Central pain mechanisms in chronic pain states – Maybe it is all in their head. Best Practice &; Research Clinical Rheumatology. 25(2):141-54.

12. Flor H, Braun C, Elbert T, Birbaumer N. (1997). Extensive reorganization of primary somatosensory cortex in chronic back pain patients. Neuroscience Letters. 224(1):5-8.
13. Ahmed AF. (2011). Effect of sensorimotor training on balance in elderly patients with knee osteoarthritis. Journal of Advanced Research. 2(4):305-11.
14. Janda V, Bullock-Saxton J, Vavrova M. (1990). Sensory motor stimulation: Body Control Videos; .
15. Riemann BL, Lephart SM. (2002). The sensorimotor system, part I: the physiologic basis of functional joint stability. Journal of athletic training.37(1):71.