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CORE STABILIZATION AND BOSU BALL EXERCISE INTERVENTIONS: THEIR COMPARATIVE EFFECTS ON BALANCE, AGILITY, AND POWER IN OLDER ADULTS

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ABSTRACT

This investigation explored how core stabilization and Bosu ball exercises impact dynamic balance, agility, and power in older adults. Aging often leads to decreased balance and stability, which can affect independence in daily activities and overall quality of life. The core stabilization program was designed to address these issues, while Bosu ball exercises were evaluated for their effectiveness in enhancing balance. The goal was to identify methods that could help improve functional outcomes and support better quality of life for the elderly. This experimental comparative study, conducted at Physiotherapy OPD with a sample size of 30 subjects, aimed to evaluate the effects of core stabilization and Bosu ball exercises on dynamic balance, agility, and power in older adults. Participants, aged 60 and above, were included if they were mentally stable and capable of understanding instructions, while those who were uncooperative, had recent surgeries, were unwilling to participate, or were under 60 were excluded.

Over a period of 4 weeks, Group A completed core stabilization exercises five times a week, whereas Group B performed Bosu ball exercises for 30 minutes per session, with each set consisting of 5-8 repetitions and a 2-minute rest between sets. The study assessed outcomes using the Berg Balance Scale (BSS) and the Functional Reach Test, comparing pre- and post-intervention scores to determine the effectiveness of the interventions. On comparing pre test and post test within group A & group B on berg balance scale (BBS)score & functional reach test (FRT)score shows significant difference in the mean values at $P \leq 0.05$. This study concluded that bosu ball exercise was best among geriatric populations. It improves the power, agility and balance postural stability when compared to the core stability exercises.

Keywords: Core stabilization, Bosu Ball, Balance, Geriatric population

INTRODUCTION

Individuals aged 65 years and older are classified as older adults, and around 30% of this population experiences at least one fall annually **[1]**. Aging is associated with diminished balance and muscle strength, which contributes to gait disturbances and increased risk of falls **[2]**. Balance denotes the tendency of the body to sustain its centre of gravity within the stability limits established by its base of support. Core muscles serve as the kinetic link, transferring torque and angular momentum between the upper and lower extremities during full-body movements **[3]**. Core stabilization exercises are known to enhance neuromuscular control, as well as improve muscle strength and endurance. In accordance with recent national standards, non-specific low back pain (NSLBP) is a diagnostic of exclusion that can be used once significant pathology or radicular syndrome have been ruled out as potential causes **[4]**. In cases where no particular reason can be found, NSLBP is diagnosed. Core stabilization is the first-line treatment for persistent NSLBP, according to European standards. The moment the center of gravity shifts away from the base of support, it can lead to loss of balance, a typical problem in the elderly population **[5]**. To maintain balance, functional awareness of the BOSU ball can help accommodate changes in the center of gravity. Approximately 35% of adults over the age of 65 experience falls annually, with significant implications for their confidence and independence. These falls can lead to hospitalization, long-term care, or even death **[6]**.

Proprioceptive abilities decline naturally with age. Structures like muscle spindles, Golgi tendon organs, and joint capsule mechanoreceptors provide information on joint position and movement, but pathologies such as peripheral neuropathy or degenerative joint disease can disrupt

proprioception **[7]**. Reduced physical activity, inadequate nutrition, and a lack of exercise lead to gradual muscle weakness and decreased functional capacity, heightening the risk of falls in the elderly. The BOSU ball, a half-dome shaped structure with a solid plastic platform and inflatable rubber hemisphere, can be used on either side. It is widely utilized by fitness and medical professionals. Exercising on unstable surfaces such as the BOSU ball has been suggested to increase proprioceptive demands and challenge muscles more than exercises performed on stable surfaces **[8]**. This piece of equipment helps engage core muscles more effectively than exercises on flat, stable surfaces, enhancing trunk stability and balance.

In older adults, BOSU ball exercises play a crucial role in improving balance and overall functional fitness. It is also beneficial for rehabilitation following injury or surgery across different populations **[9]**. It has been established that proprioceptive workouts utilizing unstable surfaces, like Swiss balls or BOSU balls, enhance lower limb strength, flexibility, and balance. People can perform daily tasks more easily when they have better balance. One instrument that is frequently used to estimate fall risk and evaluate rehabilitation results is the Berg Balance Scale (BBS) **[10]**. The BBS is a 14-item assessment tool that uses direct performance observation to quantitatively assess older individuals' balance and fall risk. Specific fall-prevention information is provided to participants based on identified risk factors from questionnaires and geriatric assessments **[11]**.

The use of the BBS as a binary predictive tool for identifying individuals at higher fall risk has yielded mixed results in community-dwelling older adults. Postural balance denotes a tendency to sustain the centre of mass within the confines of the base of support, coordinating rapid shifts of body mass in various directions **[12]**. The diversity of methods used to assess postural balance presents challenges in selecting the most appropriate instrument for clinical or academic use. One measurement assesses the horizontal distance traveled by the third metacarpal, which can be measured with a ruler or tape. The test evaluates balance during gait and includes eight pre-determined challenging functional tasks, in comparison with other assessments such as the Timed Up and Go test **[13]**.

This study contributes novel insights into the effectiveness of Bosu ball exercises compared to traditional core stabilization exercises, specifically in enhancing dynamic balance, agility, and power in older adults. While previous research has established the benefits of core stabilization in improving balance, this work uniquely highlights the

superior efficacy of Bosu ball exercises in achieving significant improvements in balance and functional performance metrics. Furthermore, it emphasizes the importance of unstable surface training in enhancing proprioception and neuromuscular control, addressing a critical need for effective rehabilitation strategies tailored for the geriatric population. By providing comparative data on these two exercise modalities, this research offers practical implications for developing targeted interventions aimed at reducing fall risk and improving overall functional mobility in older adults.

MATERIALS AND METHOD:

Selection and Description of Participants:

This experimental comparative study, conducted over a three-month period at the Outpatient Physiotherapy Department. This study was conducted in accordance with the ethical standards of the Institutional Review Board and adheres to the principles of the 2013 Declaration of Helsinki. All participants provided informed consent prior to enrollment, ensuring their voluntary participation and understanding of the study's procedures and potential risks. The research used a prior to and following the test design, with study attendees chosen by random sampling. The participants were individuals aged 60 years and above, who were mentally sound and able to follow instructions. Exclusion criteria encompassed those who were uncooperative, had recently undergone surgeries, were unwilling to participate, or were younger than 60 years. The study assessed outcomes using the Berg Balance Scale (BBS) and the Functional Reach Test to evaluate dynamic balance and stability.

Procedure

Prior to the commencement of the procedure, every single participant submitted their informed consent. Participants were given a thorough explanation of the process and were chosen based on predetermined inclusion and exclusion criteria. Thirty male and female volunteers with postural instability (geriatric population) were selected for the investigation. Subsequently, the individuals were randomly allocated between two groups. While Group B (n=15) performed BOSU ball exercises, Group A (n=15) got core stabilization exercises. Pre- and post-intervention results were evaluated using the Functional Reach Test and the Berg Balance Scale.

INTERVENTION PROTOCOL

Group A - Core Stabilization Exercises: Treatment Protocol and Assessment Outcomes [Table 1]:

The intervention comprised five sessions per week over a duration of four weeks, conducted with participants in either a prone or supine position on a mat. Core stabilization exercises were utilized to

enhance the patients' stability. The primary objective of this intervention was to improve core stability and balance through a structured exercise regimen. This approach underscored the significance of core stabilization in preventing falls and enhancing functional mobility among older adults **[14]**. Participants were assessed using the Berg Balance Scale, Functional Balance Assessment, and Functional Reach Test both prior to and following the treatment to measure the outcomes. The anticipated results aimed to quantify improvements in balance and stability as evaluated through validated assessment tools.

Group B - BOSU Ball Exercises: Treatment Protocol and Assessment Outcomes [Table 2]:

The intervention involved five sessions per week, each lasting 30 minutes, over a duration of four weeks. Each exercise set consisted of 5 to 8 repetitions, with a 2-minute rest period between sets. The procedure was performed with participants in a standing position, incorporating BOSU ball exercises to improve balance. The primary objective of this intervention was to enhance balance and stability through structured dynamic exercises. This approach underscored the significance of balance training in preventing falls and improving functional mobility among older adults.[15] Participants were assessed using the Berg Balance Scale, Functional Balance Assessment, and Functional Reach Test before and after the treatment to measure outcomes. The anticipated results aimed to quantify improvements in balance and stability as evaluated through validated assessment tools.

Table 1: Group A - Core Stabilization Exercise Protocol

Exercise Name	Starting Position	Movement Instructions	Sets	Repetitions	Holding Time	Key Muscles Engaged	Notes/Modifications
Knee Planks	Prone lying, elbows bent, weight on forearms	The patient lifted their body so that the weight was on their elbows and knees, kept their back straight, and contracted their core, avoiding dropping or rising their hips.	1-3	N/A	30 seconds	Core, shoulders, Lower back	Modified by reducing holding time if needed; progressed to full plank once strength improved.
Leg Lift	Supine, legs extended, hands under lower back	The patient lifted their legs 12 inches off the ground and then slowly lowered them back to the starting position; modifications included lifting one leg at a time if needed.	1-3	10-20	N/A	Abdominals, hip flexors	Started with one leg at a time or with bent knees for beginners.
Reverse Crunch	Supine, feet in the air	The patient lifted their pelvis off the floor while keeping their hands flat on the ground for stability, then returned to the starting position.	1-3	10-20	N/A	Lower abdominals, hip flexors	Kept the movement controlled to avoid strain on the lower back; kept hands firmly on the ground for support.

Table 2: Group B - BOSU Ball Exercises: Treatment Protocol

Exercise Name	Starting Position	Movement Instructions	Sets	Repetitions	Holding Time	Key Muscles Engaged	Notes/Modifications
BOSU Compressions	**Standing on BOSU with feet spaced evenly**	**Transferred weight between feet while employing arms for equilibrium; traversed the surface for increased challenge.**	**1-3**	**5-8**	**N/A**	**Core, legs, balance**	**Used as a transitional exercise to relax legs and feet while enhancing balance.**
BOSU Leg Abduction	**Right foot on BOSU, left leg hanging free**	**Elevated the left leg over the BOSU laterally or anteriorly while maintaining core engagement and shoulder alignment.**	**1-3**	**5-8**	**N/A**	**Hip abductors, core**	**Ensured proper alignment to maintain balance; performed slowly for better control.**
BOSU Body Weight Squat	**Standing on BOSU with feet straight**	**Flexed knees to descend into a squat, mimicking the action of sitting back on a chair; maintained a straight back, upright torso, and extended arms for equilibrium.**	**1-3**	**5-8**	**N/A**	**Quadriceps, hamstrings, glutes, core**	**Focused on maintaining a straight back; adjusted squat depth according to individual comfort level.**

Statistical Analysis

Combining inferential and descriptive statistical techniques the collected data was analyzed upon methodical arrangement. The Statistical Package for the Social Sciences (SPSS) version 24 was used to assess all parameters, setting a 95% confidence interval and a significance criterion of $p < 0.05$ for each analysis. The data's normality was assessed using the Shapiro-Wilk test. The use of parametric statistical tests was justified by the Shapiro-Wilk test findings, which showed that the dependent variables had a normal distribution ($p > 0.05$). An independent t-test (Student's t-test) was used to examine differences between the groups, and a paired t-test was used to evaluate statistical differences within the groups.

RESULTS

When Group A and Group B's mean scores on the Berg Balance Scale (BBS) were compared, both groups' post-test mean values significantly increased. Interestingly, the mean score of Group B (doing BOSU ball exercises) was 45.46 ± 4.45, higher than the mean score of Group A (doing core stabilization exercises), which was 37.80 ± 5.84 ($p < 0.05$). The null hypothesis was rejected as a result of this result **[Table 3 & 4]**.

Table 3: Comparison Of Berg Balance Scale Score Between Group – A and Group - B In Pre And Post Test

TEST	GROUP - A		GROUP - B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	30.00	6.64	29.86	6.22	.057	28	0.955*
POST TEST	37.80	5.84	45.46	4.45	-4.04	28	.000**

(*- P > 0.05 - Not Significant) & (- P ≤ 0.05 - Significant)**

Table 4: Comparison Of Berg Balance Scale Score Within Group – A and Group - B Between Pre Test And Post Test

GROUPS	PRE TEST		POST TEST		t - TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
GROUP- A	30.00	6.64	37.80	5.84	14.32	0.000**
GROUP- B	29.86	6.22	45.46	4.45	15.20	0.000**

(- P ≤ 0.05 - Significant).**

Table 5: Comparison Of Functional Reach Test Score Between Group – AAnd Group - B In Pre And Post Test

TEST	GROUP - A		GROUP - B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	4.48	1.04	4.79	1.27	-0.723	28	0.476*
POSTTEST	7.37	.852	8.78	1.08	-3.96	28	.000**

(*- P > 0.05 - Not Significant) & (- P ≤ 0.05 - Significant).**

Table 6: Comparison Of Functional Reach Test Score Within Group – A And Group - B Between Pre Test And Post Test

GROUPS	PRE TEST		POST TEST		t - TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
GROUP- A	4.48	1.04	7.37	.852	18.67	.000**
GROUP- B	4.79	1.27	8.78	1.08	37.89	.000**

(- P ≤ 0.05 - Significant).**

DISCUSSION

The investigation intended to assess the impacts of core stabilisation exercises and BOSU ball workouts on dynamic balance, agility, and power in the elderly population. Thirty participants who fulfilled the inclusion criteria were allocated into two groups. All individuals underwent screening before and after the intervention employing the Berg Balance Scale (BBS) and the Functional Reach Test.

Group A engaged in core stabilization exercises, while Group B focused on BOSU ball exercises. In a research Ponde K *et al*. demonstrated that core stability exercises effectively enhance motor control training, restoring postural control and increasing the range of motion. These exercises are particularly suitable for older adults, as the motor learning involved in core training can improve muscle reflexes and enhance proprioception, which are critical for maintaining balance **[16]**. Rozzi *et al*. noted that balance training contributes to stability and can help restore ankle stability, thereby improving the proprioceptive pathways affected by instability, this improvement yields enhanced stability and decreased sway metrics **[17]**. Soderman's study underscored the significance of balance platform activities for mitigating catastrophic lower limb injuries,

accentuating the critical function of stability in general physical health **[18]**. Behm *et al*. assert that the primary goal of training programs with physioballs or BOSU balls should emphasise on stability, balance, and proprioceptive skills rather than just concentrating on strength growth **[19]**.

Concordantly Priyadharshini S *et al*. analysed the centre of pressure (CoP) and average sway velocity, revealing that BOSU ball workouts significantly challenged both CoP and sway velocities. Consistent inversion and eversion movements, together with the associated peroneal muscle activity monitored by proprioceptors, may augment stability by improving afferent pathway activation **[20]**. The findings of U Granacher *et al*. who examined the biomechanical impacts of balance training, significantly substantiated this, emphasising the importance of dynamic workouts in enhancing stability and functional outcomes in the elderly **[21]**.

Overall, these studies suggest that incorporating BOSU ball exercises alongside core stabilization techniques can yield significant benefits in improving balance, agility, and dynamic stability in the geriatric population, ultimately contributing to fall prevention and enhanced quality of life.

CONCLUSION

This study concluded that BOSU ball exercises were more effective for geriatric populations than core stabilization exercises, significantly enhancing power, agility, and postural balance. Notable differences were observed in the post-test results of the Berg Balance Scale and the Functional Reach Assessment Scale between Group A and Group B. The implementation of BOSU ball exercises effectively reduced postural instability while improving and sustaining balance, power, and agility among older adults.

When comparing both groups, Group B exhibited a significant improvement in functional activities and balance. The findings provided compelling evidence supporting the integration of BOSU ball exercises into physical therapy regimens as the superior approach for enhancing balance and functional capabilities in geriatric patients. Participants reported that exercises performed on unstable surfaces, such as the BOSU ball, were not only more engaging but also perceived as safer, more effective, and more challenging for balance training in older adults. Overall, BOSU ball exercises demonstrated greater effectiveness than core stabilization exercises in improving balance in the elderly population.

Study constraints:

The study had a number of drawbacks, chief among them being its emphasis on patients between the ages of 60 and 80. Furthermore,

the study had a brief duration and a rather small sample size. Additionally, the study was only carried out in one location, which can have an impact on how broadly applicable the results are.

Recommendations of the Study:

To enhance the robustness of future research, it is recommended to include a larger sample size and extend the duration of the study. Additionally, conducting multi-center studies would provide a more comprehensive understanding of the interventions. Lastly, exploring different age groups would help in evaluating the effects of the interventions across a broader population spectrum.

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REFERENCES:

[1] Guccione AA, Avers D, Wong R. Geriatric physical therapy-ebook. Elsevier Health Sciences; 2011 Mar 7.

[2] Ambrose AF, Paul G, Hausdorff JM. Risk factors for falls among older adults: a review of the literature. Maturitas. 2013 May 1;75(1):51-61.

[3] Almansoof HS, Nuhmani S, Muaidi Q. Role of kinetic chain in sports performance and injury risk: a narrative review. Journal of Medicine and Life. 2023 Nov;16(11):1591.

[4] Han CS. *Key issues in diagnosis and targeted treatment of low back pain* (Doctoral dissertation).

[5] Akhtar MW, Karimi H, Gilani SA. Effectiveness of core stabilization exercises and routine exercise therapy in management of pain in chronic non-specific low back pain: A randomized controlled clinical trial. Pakistan journal of medical sciences. 2017 Jul;33(4):1002.

[6] Vieira ER, Palmer RC, Chaves PH. Prevention of falls in older people living in the community. Bmj. 2016 Apr 28;353.

[7] Rabischong P, Rabischong P. Basic Notions on Mobility Function. Comprehensive Anatomy of Motor Functions. 2014:1-25.

[8] Brooks J. The effect of stable versus unstable surface crunches on abdominal muscle EMG in healthy females. Southern Connecticut State University; 2006.

[9] Hamad Ibrahim I. The effect of a rehabilitation program using the Bose (BOSU) Ball on the functional efficiency level in those with a torn cruciate ligament. After surgical ligament repair And normal knee rehabilitation. Assiut Journal of Sport Science and Arts. 2020 Jun 17;2020(1):149-62.

[10] Lima CA, Ricci NA, Nogueira EC, Perracini MR. The Berg Balance Scale as a clinical screening tool to predict fall risk in older adults: a systematic review. Physiotherapy. 2018 Dec 1;104(4):383-94.

[11] Saunders NW. Reliability and Validity of an Accelerometer-based Balance Assessment for Fall Risk Screening. The Ohio State University; 2013.

[12] Tesio L, Rota V. The motion of body center of mass during walking: a review oriented to clinical applications. Frontiers in neurology. 2019 Sep 20;10:999.

[13] Coulthard JT, Treen TT, Oates AR, Lanovaz JL. Evaluation of an inertial sensor system for analysis of timed-up-and-go under dual-task demands. Gait & posture. 2015 May 1;41(4):882-7.

[14] Akuthota V, Ferreiro A, Moore T, Fredericson M. Core stability exercise principles. Current sports medicine reports. 2008 Jan 1;7(1):39-44.

[15] Sawant RA, Chotai K, Patil S, Rayjade A. Effectiveness of bosu ball exercises versus thera band exercises on core stabilization and balance performance. Indian Journal of Forensic Medicine & Toxicology. 2020 Apr 29;14(2):200-6.

[16] Ponde K, Agrawal R, Chikte NK. Effect of core stabilization exercises on balance performance in older adults. International Journal of Contemporary Medicine. 2021 Jan;9(1):12-7.

[17] Rozzi SL, Lephart SM, Sterner R, Kuligowski L. Balance training for persons with functionally unstable ankles. Journal of Orthopaedic & Sports Physical Therapy. 1999 Aug;29(8):478-86.

[18] Söderman K, Werner S, Pietilä T, Engström B, Alfredson H. Balance board training: prevention of traumatic injuries of the lower extremities in female soccer

players? A prospective randomized intervention study. Knee surgery, sports traumatology, arthroscopy. 2000 Nov;8(6):356-63.

[19] Behm DG, Muehlbauer T, Kibele A, Granacher U. Effects of strength training using unstable surfaces on strength, power and balance performance across the lifespan: a systematic review and meta-analysis. Sports Medicine. 2015 Dec;45:1645-69.

[20] Priyadharshini S, Kamalakannan M, JP AA, Anitha A, Ramana K. Effects of Static Somatosensory Balance Training Versus Bosu Ball Training on Balance For Institutional Elderly Population. Indian Journal of Physiotherapy & Occupational Therapy. 2024 Jan 2;18.

[21] Granacher U, Muehlbauer T, Gruber M. A qualitative review of balance and strength performance in healthy older adults: impact for testing and training. Journal of aging research. 2012;2012(1):708905.