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Research Article

Effect of Resistance and Flexibility Exercise Intervention on Balance in Older Adults

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Abstract: The main objective of our study is to analyze the effect of resistance and flexibility exercise intervention on balance in older adults**.** Balance is the ability to maintain an upright posture during static and dynamic tasks. Maintaining balance involves a complex interaction between intrinsic factors, including peripheral, visual and vestibular sensation and muscle factors, and the interplay between the neural network and motor output, which are processed and mediated centrally. Programs to increase physical exercise among elderly persons have been found to be beneficial to health. Evidence suggests that training should combine both flexibility exercises and resistance exercises. Berg Balance Scale was the outcome measure. Twenty subjects were selected and divided into two groups. Group A (10 subjects) were given Resisted exercises for 40-45 minutes with two sets of 10 – 12 repetitions for ten weeks. Group B (10 subjects) were given flexibility exercises for 40-45 minutes and included 10–12 repetitions for ten weeks. On comparing the mean values of Group A & Group B on the Berg Balance Scale score, it shows a significant increase in the post-test mean values in both groups, but (Group A - Resistance Exercise) shows 51.10 which has the higher Mean value is effective than (Group B - Flexibility exercise) 46.40 at $P \leq 0.001$. Comparing Pretest and Posttest within Group A & B on the Berg Balance Scale score shows a highly significant difference in mean values at $P \leq 0.001$. This study concludes that resisted exercise significantly improved balance in older adults than in flexibility exercise.

Key Words: Balance, Berg Balance Scale, Stretch, Static and Dynamic Balance Older adults, flexibility, resistance exercise

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1. INTRODUCTION

"Older adults" emerged, citing images of fragility, physical decline and long-term care. Balance is maintaining a good position during static and dynamic tasks. Maintaining balance means having a between interaction.[1]. Aging is a dynamic and progressive process in which morphological, functional, hemodynamic, and psychological changes reduce the individual's ability to adapt to the environment, thus heightening vulnerability to the onset of pathological processes, with muscle mass and Strength and eventually diminishing[2]. Once an older adult attains a history of suffering falls, the likelihood of experiencing subsequent falls becomes increased. It has been shown that individuals prone to falls possess lesser Strength and power in their lower extremities compared to those without a history of falls[3]. Numerous exercises have been studied for their benefits on populations of older adults. For instance, walking training helps enhance walking ability and delay the onset of mobility impairment in older adults (Malatesta, Simar, Saad, Pre'faut, &Caillaud, 2010). In contrast, strength and coordination training can lessen the amplitude of postural tremors in older adults (Keogh, Morrison, & Barrett, 2010). Older women who participated in a multi-component training programmer with weight-bearing exercises saw improvements in their bone density, muscle strength, and balance (Marques et al., 2011), the latter of which is particularly significant because balance is a requirement for mobility (Frank & Patla, 2003). The rate of falls and severity of the resulting complications increase dramatically with age. The majority of falls occur due to multiple interacting factors. For community-dwelling elderly, the two most important intrinsic predictors for a fall accident are taking medications and having a poor balance[4]. Low fitness in old age is associated with greater weight loss and lean mass loss than at higher fitness levels. Such changes in body composition also imply a greater risk of morbidity, disability, and even mortality[5]. Among the age-related changes, the ones that contribute the most to loss of function after autonomy reductions in muscle strength, flexibility, and cardiorespiratory capacity[6]. Resistance training is widely used among older adults, as physical function is closely related to Strength and muscle mass. Many reports have described the benefits of resistance training in older adults, improving muscle strength, power, endurance and, mass[7]. Resistance training is an effective way to achieve optimal gains in muscle mass and Strength. It has also been well-documented in attenuating various forms of skeletal muscle wasting (e.g., sarcopenia.Moreover, it has been demonstrated that with appropriate training, older adults can reverse strength and muscle mass deficits to younger levels[8]Flexibility training is the least researched intervention in older adults. Flexibility represents the ability to move a joint through its full range of motion. The range of motion of a certain joint depends on bone, muscle and connective tissue integrity as well as other factors such as pain and the ability to produce an adequate amount of muscle force[9]. Some flexibility exercises for UPPER LIMB: Shoulder – standing arm swing, shoulder pass-through, Arm – Eagle arm, cross arm stretch. (Shoulder and upper arm exercises for deltoid, trapezius, and rhomboid muscles. For LOWER LIMB -Hamstring stretch (Back of leg exercises for hamstring muscle are given to improve balance. Some resisted exercise is stepped up-external force with dumbbells, the lunges-external force with dumbbells, and wall pushups – internal force. The main aim of the current study is to analyze the effect of resistance and flexibility exercise intervention in balance on older adults.

2. METHODOLOGY

2.1. Participants

This experimental study was done at ACS Medical College, and Hospital. Fifty subjects were assessed for eligibility. Ten subjects were needed to meet the inclusion criteria. Five subjects declined to participate, and two did not participate for other reasons). Five Subjects were lost to follow-up, three subjects discontinued the intervention, and five subjects were excluded from the analysis. Twenty individuals completed the intervention and were divided into two groups randomly. The subjects are older adults aged 60 to 65were treated for about ten weeks.

2.2. Inclusion Criteria

Before including older persons in the programme, a physical condition assessment was done. It was important to make sure that each potential participant's physical health was sufficient to allow for participation in the physical activity training involved in this study and avoid unwarranted hazards. After that, all participants were monitored to see if the exercise programme had caused any changes in the parameters that had been measured. A thorough medical history, including pharmacological treatments, as well as the subjects' level of interest in and regular amount of physical exercise, were also provided. In addition, the musculoskeletal system was examined physically, and the heart rate and blood pressure were measured. All these data provided a general health evaluation to ensure early identification of any absolute or relative contraindications or limitations on physical exercise. Older adults with corona-free symptoms of male and female adults aged 60 to 65 years, were included.

2.3. Exclusion Criteria

Candidates were excluded for failing the physical condition examination before the study period. Subsequently, participants were excluded for attending training sessions with inappropriate clothing for sports, being absent from more than 20% of the sessions, or refusing to sign the consent information and the attendance register. Other exclusion criteria were based on reviewing past medical records. Older adults with a history of stroke, other neurological diseases, current diabetes, cardiovascular disease, uncontrolled hypertension and corona symptoms adults were excluded from this study.

2.4. Exercise Intervention

20 Subjects with the age group of 60 -65 years are selected. They are divided into two groups. Group A (10 subjects) were treated using Resisted exercises [step up-external force with dumbbells, the lunges-external force with dumbbells, wall pushups – internal force]. Group A will be given two sets of 10 – 12 repetitions for ten weeks. Group B (10 subjects) will be taught to do flexibility exercises for UPPER LIMB: Shoulder – standing arm swing, shoulder pass-through, Arm – Eagle arm, cross arm stretch. (Shoulder and upper arm exercises for deltoid, trapezius, and rhomboid muscles. For LOWER LIMB -Hamstring stretch (Back of leg exercise for hamstring muscle. In Group B, each session will be given for 40-45 minutes, including 10– 12 repetitions and a 10-second hold for ten weeks. (Intervention mentioned in table)

2.5. Measurement of Balance

The subject should understand that they must maintain balance while attempting the tasks. For administering this test, not much training is required. The scale is available for download and online completion. There are 14 mobility challenges included, and they range in difficulty. Three domains—sitting balance, standing balance, and dynamic balance—are used to categorize the jobs. The evaluation of sitting unsupported is the task in the sitting balance. Standing on one foot, turning to look behind, taking something off the floor, reaching forward with outstretched arms, and putting one foot in front of the other are all examples of standing in balance while unsupported. In the last domain, the dynamic balance is assessed when the person moves from sitting to standing and from a standing to a sitting position, transfers, turns 360 degrees, and places one foot on a step. Each item is scored using a 5-point ordinal scale with a maximum score of 56 and a range of 0 to 4. Generally, a score of 0 is assigned when the person cannot do the task, and a score of 4 is assigned when they can do so independently. Other criteria that influence the points awarded are the amount of time needed to complete the activity, the time a position can be held, and the level of supervision or support required. The points awarded vary depending on how much extra time, supervision, or the requirement for assistance technologies is needed. The 14 tasks each come with specific instructions on how to perform. For example, when testing standing unsupported with eyes closed, the instructions are to "close your eyes and stand still for 10 seconds". If the patient can stand for 10 seconds safely, a score of 4 is given. If able to stand for 10 seconds with supervision, score 3. Able to stand for 3 seconds, a score of 2. Unable to keep eyes closed for 3 seconds but stays safely gives a score of 1, and a score of 0 is given if the patient needs help to keep from falling.

2.6. Procedure

The Institutional Review Board approves the physiotherapy faculty's manuscript (IRB REF NO: BPT IV E /PHYSIO/ IRB/2020-2021). All the procedures were performed under ethical standards. The older men and women, ranging from 60 to 65 years of age, were recruited from the outpatient department, ACS Medical College and hospital. The patients signed an informed consent form to participate in the study. Patients were screened by both inclusion and exclusion criteria. Twenty subjects were randomly selected and divided into two groups.

Group A [Resisted Exercise]: Is any form of active exercise in which an outside force resists dynamic or static muscle contraction.

Table 1: Resisted Exercise

EXERCISE	Program component	DURATION
STEPUP (external force with dumbbells): 	• Hold a pair of dumbbells at the sides, and they were asked to place one foot on the bench with their knee should be at 90°. • And the subjects were asked to keep the other leg straight and firmly planted on the ground and push their shoulder back and chest out. • They push their top foot to raise their body over the platform. • **Muscles involved:** Quads, hamstrings, gluteus, and core.	40-45 Minutes
LUNGES (external force with dumbbells): 	• The subjects were asked to stand upright and hold a pair of dumbbells at their side, with their palm should face their body. • Now asked to lunge forward as far as they could with their right leg and asked to bend the trailing knee so that it almost brushed the floor. • And then asked to use the heel of their right foot to push their upper body and back to the start position. • Also, they repeated the exercises with the opposite leg. • **Muscles involved:** Gluteus, hamstrings, Quadriceps, calf muscles.	
WALL-PUSHUP (with internal force):	• The subjects were asked to place their hands against the wall directly in front of their shoulder.	

- Make sure their body is straight, and ask them to bend their elbows to lean towards the wall.
- They were said to stop with their face close to the wall and asked to straighten their arms to push their body away from the wall.
- **Muscles involved:** Chest muscles-pectoralis major and minor, Shoulder muscles-deltoid, Back muscles-latissimus-dorsi, Rhomboids, Trapezius.

Group B [Flexibility Exercise]: This is the range of motion in a joint or group of joints or the ability to move joints effectively through a complete range of motion.

Table 2: Flexibility Exercise

EXERCISE	Program component	DURATION
STANDING ARM SWING 	The subjects were asked to stand tall with their arm by their side. And engage their core and swing their arms forward until they are as high as they can. Make sure they don't raise their shoulder. Return to starting position and Repeat. Muscles Involved: Primary muscles: **Shoulders, arms** Secondary muscles: **Upper back, chest**	40-45 Minutes
SHOULDER PASS-THROUGH 	They were asked to stand with feet shoulder-width apart and their arms in front of their body and asked to hold the stick with an overhand grip. Now, their arms became wider than shoulder width. Make sure the stick is raised parallel to the floor. Hold it for a few seconds and Repeat. Muscles Involved: **Rotator cuff muscles**	
EAGLE ARM 	They asked to inhale and stretch their arms out to their side. And then asked to exhale, swing the right arm under the left arm and grab their shoulders with their opposite hand. They were inhaling lift, the elbows a few inches higher. Exhaling, relax their shoulder down away from their ears. Muscles Involved: **Trapezius**	
CROSS ARM STRETCH: 	Asked to stand tall, grab one arm above their elbow with their opposite hands and pull it across their body towards their chest. Make sure that their elbows are below shoulder height. Hold for a few seconds and Repeatsminor, Shoulder muscles-deltoid, Back muscles-lattisimus-dorsi, Rhomboids, Trapezius.	

HAMSTRING STRETCH

Hamstring stretch

They asked to sit straight on the floor with both legs out straight. Extended their arms and reached forward by bending at their waist as far as possible while keeping their knee straight. Hold and Repeats

3. STATISTICAL ANALYSIS

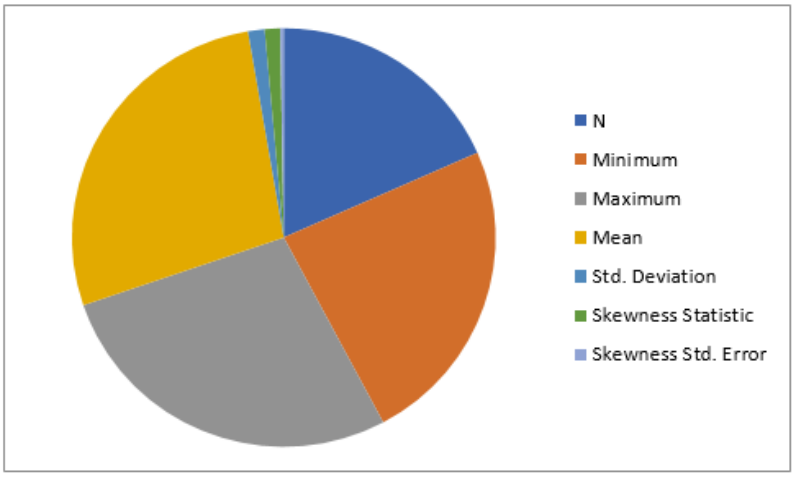
The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using IBMPSS 24 to find the statistical difference within the groups &Independent t-test (Student t-Test) was adopted to find the statistical difference between the groups.

4. RESULTS

The study includes older adults of the age group 60 to 65, of which 55% are female and 45 % are male of an age group mean 62.25 and BMI mean 30, Married 3.4 %, single 0.4%, divorce0.2%. All the subjects are not working people. On comparing the Mean values between group A & Group B on the Berg Balance Scale score, it shows a significant increase in the post-test Mean values in both groups, but (Group A - Resistance Exercise) shows 51.10 mean value with 4.76 SD, which has a higher Mean value is effective than (Group B - Flexibility exercise) 46.40 with SD 2.33 t $P \leq 0.001$. Comparing Pretest and Posttest within Group A & B on the Berg Balance Scale score shows a highly significant difference in Mean values at $P \leq 0.001$.

Table 3: Descriptive Statistics on Demographic Data – AGE & BMI

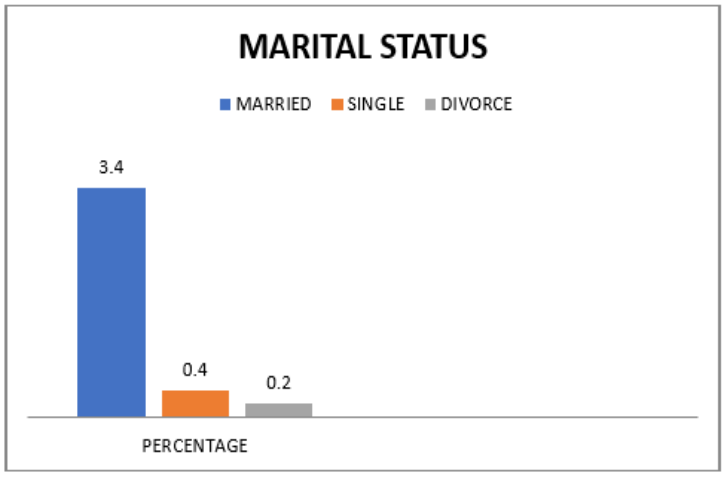
Variables	N	Minimum	Maximum	Mean	Std.Deviation	Skewness	
						Statistics	Std. Error
AGE	20	60.00	65.00	62.2500	1.94327	.182	.512
BMI	20	26	30	30	1.37808	1.276	.291



Graph I: AGE

Table 4: Descriptive Statistics on Demographic Data – MARITAL STATUS

	N	Total	Percentage
Married	20	17	3.4
Single	20	2	0.4
Divorce	20	1	0.2



Graph II: MARITAL STATUS

Table 5: Comparison of Berg Balance Scale Score Between Group – A and Group - B in Pre and Post Test

# BBS	#Group - A		#Group - B		t - TEST	df	Significance
	Mean	SD	Mean	SD			
Pre Test	43.70	3.74	43.80	4.63	-.053	18	.958*
Post Test	51.10	2.33	46.40	4.76	2.80	18	.000***

(*- P > 0.05), (- P ≤ 0.001)***

The above table reveals the Mean, Standard Deviation (SD), t-test, degree of freedom(df) and p-value between (Group A) & (Group B) in the pretest and post-test weeks. This table shows no significant difference in pretest values between Group A & Group B (*P > 0.05). This table shows that statistically highly significant difference in post-test values between Group A& Group B (***- P ≤ 0.001)

5. DISCUSSION

This study's objective was to analyze the effect of resistance and flexibility exercise intervention in balance on older adults. As for the first research hypothesis, we wanted to determine if participating in a resistance and flexibility exercise intervention can improve an older adult's balance. Balance is defined as the ability to maintain an upright posture during both static and dynamic tasks[21]. Maintaining balance involves a complex interaction between intrinsic factors, including peripheral, visual, and vestibular sensation and muscle factors, as well as the interplay between the neural network and motor output, that are processed and mediated centrally [22]. All of these factors are affected by normal ageing processes. Flexibility is important for maintaining or improving joint range of motion in the aged. Exercise protocols developed for the elderly include resistance exercises to develop musculoskeletal fitness in several joints. Maintaining balance involves a complex interaction between intrinsic factors that include peripheral, visual, and vestibular sensation and muscle factors, as well as the interplay between the neural network and motor output, which are processed and mediated centrally. All of these factors are affected by normal ageing processes. Patterns of muscle use change as an individual ages. Strength and power decline, and the speed of neural processing and the number of sensory receptors decrease. These changes result in volitional and reflexive motion alterations because neural processing and sensory receptors are major contributors to effective postural balance control. Poor balance is a major risk factor for falls. Fall rates increase with age, and the implications and costs of falling for individuals, and society, are high and projected to increase[11]Progressive resistance training has positive effects on Strength, bone density, depressive symptoms, metabolic profile, risk factors for diabetes and heart disease, risk factors for falls, walking endurance and balance of elderly people[12]Older adults are less likely to participate in formal fitness programmers. However, there is evidence to support the benefits of a programmer that incorporates both home-based and centre-based training to maintain the advantages of flexibility exercises for static and dynamic balance. Aged persons who struggle with flexibility may benefit from programmes that find resistance training difficult or boring. The advantages of including strength training on different days and flexibility programmes call for more investigation. The present study analyzed the effects of resistance and flexibility exercises on balance in older adults. After the intervention, there was a mean improvement in the berg balance scale score. Balancing exercises assist in maintaining postural control, which is crucial for keeping balance. Older persons are more susceptible to sickness and neuromotor dysfunction due to ageing. An illness that affects the postural-control system is likely to have an impact on balance as well. Exercise preserves and enhances postural control, prevents disease, and slows down the degeneration of the musculoskeletal system. Marie-Louise Bird et al. reported significant improvements in balance performance were achieved with resistance-training and standing flexibility-training programs in healthy untrained older adults[13]. I.G. Fatouros et al. showed that resistance training improves the range of motion in various joints in healthy inactive elderly. Therefore, it appears that resistance training is an effective exercise mode to enhance flexibility, an important fitness parameter contributing to optimal health and functional status as well as independent living of the elderly[23].Sheri r. Colberg et al. concluded that eight weeks of combined flexibility and resistance training caused significant strength gains in older adults with and without type 2 diabetes Exercises involving increasing resistance and strength training are proven to build muscle strength in this scenario[24]. Additionally, it has been

shown that they can help older persons with various functional impairments. In actuality, muscle ageing is a common power and tenacity. Regardless of whether they are used, they tend to increase functional independence and quality of life and decrease disability and cardiovascular disease[14]. Research has focused on determining the most effective interventions for either improving balance or reducing fall risks. Still, the multisystem and multifactorial nature of balance means prioritizing the importance of fall-risk factors for individuals in different contexts is difficult[14]Sims. Hill, Davidson, Gunn, and Huang (2007) found that older adults are less likely to participate in formal fitness programmes. However, evidence supports the benefits of a programmer incorporating home-based and centre-based training for maintaining balance here[15]. Resistance- or strength-training programs are gaining acceptability with older adults and have been reported to increase bone density, Strength, and muscle mass with a concomitant decrease in physical limitation[16]Balance and gait are very similar to those reported in the literature. Indeed, physical activity programs based on resistance strength training presented to samples of institutionalized older people do help preserve their lower limb strength or slightly increase it (Jessup, Horne, Vishen, & Wheeler, 2003), which is directly related to walking autonomously[17]The situational context of this program may have facilitated continued participation in resistance training. Many exercise programs that are the basis of research are situated in educational or research facilities. Our program varies from this, having been located in a community gymnasium, which may positively affect continuity. Older people have low participation rates in formal exercise programs (Sims, Hill, Davidson, Gunn, & Huang, 2007), and the benefits to balance of a program that includes home-based and centre-based training are supported here[25]. The benefits of flexibility exercises on static and dynamic balance are presented in this article. Flexibility programs may be useful for older adults who do not find resistance training manageable or appealing. The benefits of including flexibility programs on alternate days with resistance training warrant further investigation (Nelson et al., 2007)[27]. The flexibility program did incorporate some degree of balance training because of the nature of the flexibility tasks used in this study. For example, when participants were able, quadriceps and hamstring stretches were performed in a one-legged stance. For safety, stand-by assistance or chairs were used when required. Any activity requiring a person to maintain a static position on one leg will challenge balance control. One-legged standing for as little as 60 s three times a day has been found to reduce fall rates in older adults in residential care (Sakamoto et al., 2006)[27]. Although balance and agility differ between community-dwelling and residential-care-dwelling adults, training by this method may be useful in altering balance mechanisms, which are reflected in the force platform parameters[18]. On comparing the Mean values of Group A & Group B on the Berg Balance Scale score, it shows a significant increase in the post-test Mean values in both groups, but (Group A - Resistance Exercise) shows 51.10, which has the higher Mean value of is effective than (Group B - Flexibility exercise) 46.40. Comparing Pretest and Posttest within Group A & Group B on the Berg Balance Scale score shows a highly significant difference in Mean Values. The present study concluded that Resisted exercise significantly improved balance in older adults than Flexibility exercise.

6. CONCLUSION

This study concludes that Resisted exercise involving the Quads, hamstrings, gluteus, calf muscle muscles-pectoralis major and minor, Shoulder muscles-deltoid, Back muscles-lattisimus- dorsi, Rhomboids, Trapezius and core muscles. Yielded significant improvement in improving balance in older adults than Flexibility exercise. Balance is an important consideration in the health of elderly subjects. Balance is necessary to maintain posture, respond to voluntary movements, and react to external perturbations. This study shows a significant difference in mean values in Group A & Group B. Comparing both, Group A (Resisted exercise) showed a marked improvement in balance in older adults than Group B (Flexibility exercise).

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8. AUTHORS CONTRIBUTION STATEMENT

Prof. Dr.C.V. Senthilnathan conceptualized the idea and guided this study, G. Vaishnavi, A. Akashkumar. carried out the research study and drafted the manuscript, Dr Rajalaxmi. V, Dr Premvenketasan discussed the methodology, which resulted in Dr S. Geethalakshmi and Prof. Dr.C.V. Senthilnathan contributing to analyzing data.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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