EFFECTIVENESS OF TEN WEEKS OF BALANCE AND STRENGTH TRAINING ON DYNAMIC BALANCE OF OLDER ADULTS

EFICIENȚA UNUI PROGRAM DE 10 SĂPTĂMÂNI PENTRU ÎMBUNĂTĂȚIREA FORȚEI ŞI ECHILIBRULUI, ASUPRA ECHILIBRULUI DINAMIC AL PACIENTULUI VÂRSTNIC

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Key words: dynamic balance, balance and strength training, Berg Balance Scale, Senior Fitness Test.

Abstract.

Objectives: The purpose of this study was to evaluate the effectiveness of ten weeks of balance and strength training on dynamic balance of older adults.

Design Randomized Controlled Trial.

Setting Department of Community health and rehabilitation department, Pravara Rural Hospital (Tertiary Hospital), Loni, Tal-Rahata, Dist-Ahmednagar, Maharashtra State, India- 413 736.

Methods: A randomized controlled trial consists of 52 older adults age between 60-75 years having poor balance and strength. Strength training group (Group A) (n = 17), Balance training group (Group B)(n=18) and combination group strength and balance (Group C)(n=17) for the duration of 10 weeks. Outcome measures used were Berg Balance Scale and Senior Fitness Test.

Results: Statistical analysis showed marked improvement in all the groups but more improvement was seen in Group C ($p< 0.01$) i.e. combination of strength and balance training in improving dynamic balance and strength of older adults. Intervention did not cause falls or injuries.

Conclusion: The results of this study suggested that ten weeks of balance and strength training when given in combination helps in improving Dynamic balance of older adults age between 60-75 years.

Cuvinte cheie: echilibru dinamic, îmbunătățirea echilibrului şi forței, Scala de Echilibru Berg, test de fitness pentru seniori

Rezumat.

Obiective: Scopul acestui studiu este evaluarea eficienței a zece zile de antrenament pentru îmbunătățirea echilibrului şi forței asupra echilibrului dinamic al pacienților mai vârstnici.

Design Test de control aleatoriu.

Locație Departamentul pentru sănătatea comunității şi departamentul de recuperare, Spitalul Rural Pravara (Spital de gradul trei), Loni, Tal-Rahata, Dist-Ahmednagar, Maharashtra, India -413736.

Metode: Testul de control aleatoriu s-a efectuat asupra a 52 de pacienți vârstnici cu vârste cuprinse între 60 şi 75 de ani, cu echilibru şi forță deficitare. S-a format un grup pentru îmbunătățirea forței (Grupul A) (n = 17), un grup pentru îmbunătățirea echilibrului (Grupul B) (n = 18) şi un grup combinat (Grup C) (n = 17), timp de 10 săptămâni. Măsurătorile utilizate au fost Scala de echilibru Berg şi Testul Fitness pentru Seniori.

Rezultate: Analiza **s**tatistică a arătat îmbunătățiri la toate grupele, dar mai ales la Grupul C ($p< 0.01$), adică o combinație de antrenare a forței şi echilibrului. Intervenția nu a cauzat căderi sau accidentări.

Concluzie: Rezultatele studiului au sugerat că zece săptămâni de antrenament combinat ajută la îmbunătățirea Echilibrului dinamic al pacienților vârstnici cu vârste între 60 şi 75 de ani.

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Introduction

Aging is a complex biological process in which changes at molecular, cellular and organ levels result in a progressive, inevitable and inescapable decrease in the body's ability to respond appropriately to internal and/or external stressors [1]. Aging progressively impairs sight, vestibular input and somatosensory information, which results in a reduction of environmental perception and precision of movements. Aging reduces the number of muscles and nerve fibers which bring a reduction to muscle strength and power which further impairs functioning of movements and ability in maintaining dynamic balance. Dynamic balance is responsible for maintaining balance in angular or rotator movements of head in space. For these reasons individuals who are 60 years old may start to experience manifestations of imbalance and body instability. Therefore, simple activities like standing up or rising from a chair may become limited or even dangerous [2, 3]. Although many studies on the process of aging have revealed decline in numerous sensory & motor functions in elderly individuals, how and why one age remains unclear. Age related deterioration in balance exerts a significant negative impact on the ability to perform everyday activities safely & are a major cause of falls.

Maintaining balance requires complex interactions between peripheral and central factors such as vision, somatosensation, vestibular sensation, motor output, and musculature. These entire factors decline with advancing age [4]. Numerous studies demonstrate that impaired balance and decreased lower extremity strength are important risk factors for the loss of physical function and occurrence of falls in older adults [5]. As they age, elderly individuals experience a decrease in strength and balance that has been listed as risk factor for falls [6,7]. Older individuals with reduced leg strength exhibited 4.9 times the risk of falling compared to people with normal leg strength [4].

Globally there will be 1.2 billion people over the age of 60 by the year 2025, and by 2050 these figures will get doubled, with 80% of older people living in developing countries [10].

Approximately 30% of older adults fall each year, and for those over 75 the rates are higher [11]. Life threatening or not, falls in the elderly often result in a loss of mobility and independence that generally results in a decrease in the quality of life [4,8]. Approximately 1 in 10 falls results in a serious injury such as hip fracture, subdural hematoma, other serious soft tissue head injury [14]. Falls account for approximately 10 percent of visits to the emergency department and 6 percent of urgent hospitalizations among elderly persons. Falling can even result in death [15].

Balance exercises train all the systems which are responsible for maintaining it improves the proprioception and in turn improves motor functioning and balance [16, 17]. Balance exercises like semi-tandem, full tandem, standing on toes, standing on one foot lateral and forward reaching and tandem walking are easiest and cost effective in improving balance of older adults. These exercises provide subtle changes in balance similar to the challenges experienced in everyday life. They allow the body to learn how to make appropriate responses to maintain balance while standing still and during activities like walking, climbing stairs, picking, bending etc. [18]. Strength training by using therabands like chest press, lateral pull downs, chair squat, leg press on one foot improves strength of muscles of lower and upper limb which are weak in older adults [18]. Strength exercises using bands strengthen each major muscle group in upper and lower body. Special emphasis is given to muscles that play an important role in the maintenance of balance [18, 19].

Certain promising studies have suggested that balance training alone and strength training alone improved balance in older adults with impaired balance [20, 21, 22, 23, 24]. There is limited literature suggesting that combined balance and strength training improved balance. Despite the array of studies investigating the effectiveness of balance and strength, consensus regarding the duration of balance and strength training in combination has not been attained [4, 24, 25]. Therefore the purpose of this pragmatic randomized trial study is to investigate the clinical use of combined balance and strength training for older adults age between 60-75 years with impaired balance over a period of ten weeks.

Methods

Subjects

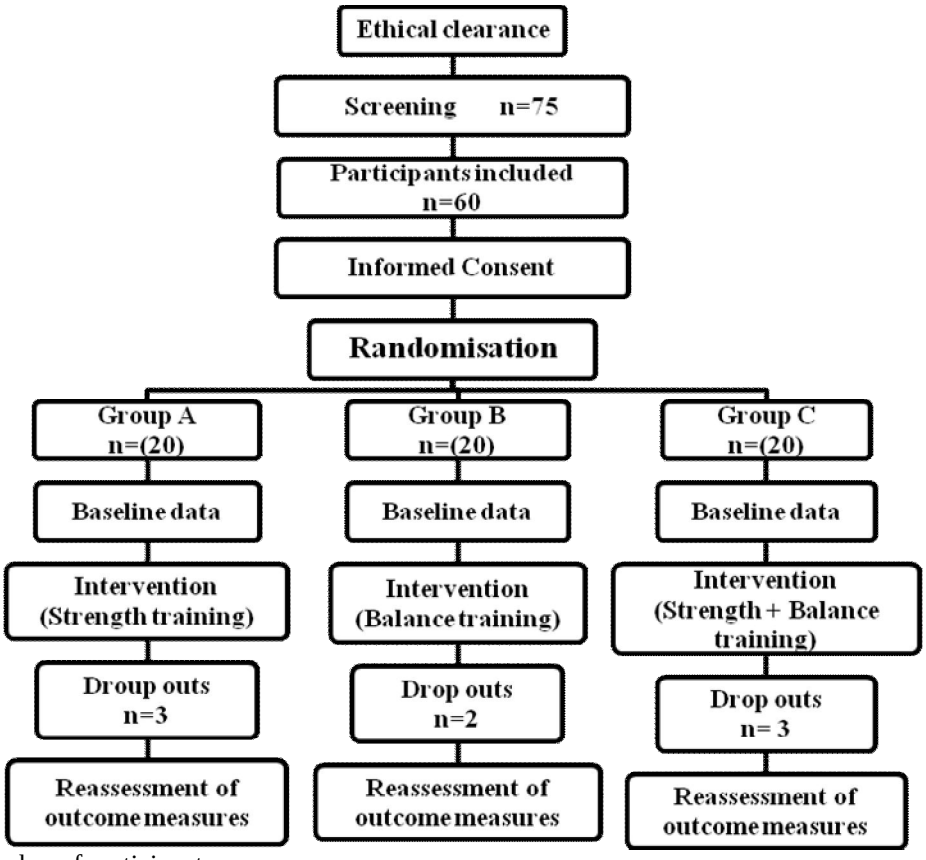
A total seventy five participants aged 60-75 years with poor balance and strength were screened for the present study. Out of which 60 were eligible based on inclusion and exclusion criteria and agreed to participate in the study. Eight of these participants dropped out of the study as they lost follow up. Group A and Group C had 17 participants and Group B had 18 participants. Criteria for inclusion in the study were participants with poor balance on Berg Balance Scale (> 45)[13], participants of age between 60 to 75 years, both males and females and participants who were able to attend pre and post test assessment sessions [4]. Participants were excluded if they have neurological condition such as stroke, and congenital abnormalities, motor neuron diseases, participants with vertigo, cardiovascular instability and with recent fractures [4].

Outcome measures

The outcome measures used in the study were Berg Balance Scale (BBS) to measure the balance and Senior Fitness Test (SFT) to evaluate the functional fitness performance before and after the intervention [26, 27]. Both the outcome measures used had considerably good reliability and validity.

Procedure

The study received approval from the Ethical Committee of Pravara Institute of Medical Sciences, Loni, Maharastra, India. After the screening as per the inclusion and exclusion criteria participants were enrolled in three groups. Prior to the participation written informed consent was taken. The intervention was given for 10 weeks (3 sessions per week lasting between 30-50 minutes). Reassessment was done after the 10 week intervention was completed (Figure 1).



n = Number of participants

Figure 1: Flow diagram showing the procedure used in the study

All the three group protocol consisted of 3 stages: Warm up, strength training or balance training or combination of both and cool down.

Warm up and cool down consisted of slow walking for 5 minutes were as strength and balance training lasted for 30-50 minutes. Strength training consisted of following components [18]:

Chest press: Participants were asked to put the theraband behind back and grasp both ends close to chest then slowly push forward like a bench press exercise and return to starting position.

Lateral pull downs: Participants were asked to hold theraband above the head at shoulder width, keeping elbows straight slowly bring the arms down to the sides, stopping at shoulder level and then slowly return to starting position .

Chair squat: Participants were asked to keep center of theraband under feet, grasp ends of theraband with hand by sides. Keep tension in band with elbows straight and then slowly return to starting position.

Leg press on one foot: Participants were asked to loop middle of theraband around foot with knee bent, standing on opposite foot then hold both ends of the band above waist and slowly straighten the knee to touch foot to floor while doing this keep the back straight. Slowly return to starting position.

Leg kicks: Participants were asked to loop centre of theraband around one ankle and stabilize other end under the other foot then kick band backward and then in front keeping knee straight.

All these exercises were repeated for 10 times. Once the participants were able to perform all these exercises comfortably progression was done by changing therabands from yellow to green.

Balance training consisted of following components [18]:

Semi-tandem: Participants were asked to stand with one foot ahead of the other as if taking step and hold for 10-30 seconds.

Full tandem: Participants were asked to stand with heel of one foot directly in front of the toes of other foot hold it for 10-30 seconds.

Standing up on toes: Participants were asked to stand up on their toes and hold it for 10-30 seconds.

Standing on one foot: Participants were asked to stand on one foot and hold it for 10-30 seconds.

Lateral and forward reaching: Participants were asked to reach forward and lateral and touch the wall without lifting their.

Tandem walking: Participants were asked to place one foot directly in front of other, touching heel to toe and then hold. Repeat this with other foot in front. Progress to taking a step or two by placing heel to toe with each step eventually try walking across the room.

Progression of Semi-tandem, Full-tandem, Standing up on toes and Standing on one foot components was done when once the participants were able to do all this four exercises for 10 times comfortably, they were asked to perform the same exercises by eyes closed. When they were able to do this also they were asked to perform the same on foam surface.

Progression of Lateral and forward reaching component was done when once the participants were able to perform it comfortably for 10 times, the distance between participant and wall was increased.

Results

Statistical analysis was done using the trial version of Graph Pad Instat software. Confidence interval was kept at 95%. Within the group analysis was done by using paired ‘t’ test for all three groups. One-way ANOVA was used to compare the difference in scores between the three groups.

Baseline characteristics across three groups were similar and are summarized in table 1.

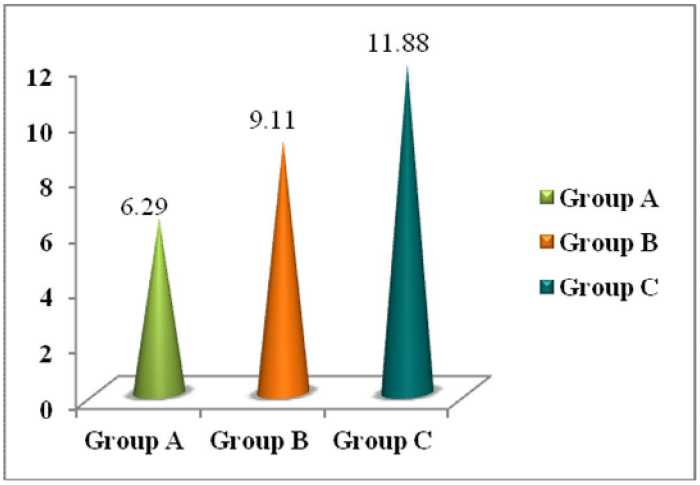
The findings of this study showed more improvement in Group C compare to Group A and Group B in terms of Berg Balance Scale (table 2 and graph 1) and Senior Fitness Test (table 2 and graph 2).

Table 1: Showing demographic profile in all the three groups

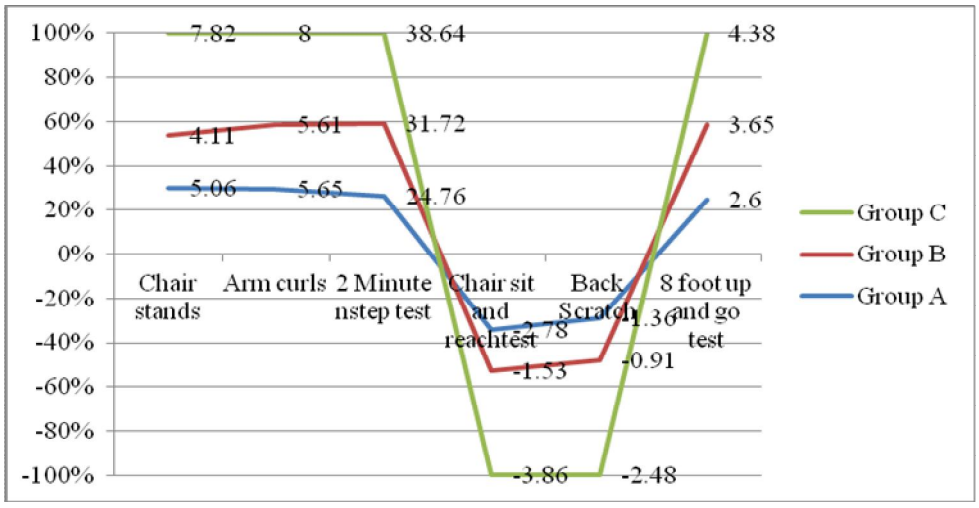
Group item	Group A	Group B	Group C	*p* value
Age	66.94±4.93	67.17±3.75	66.82±5.41	0.98
Male : Female	10:7	12/6	11/6	
Data are Mean ±SD				

Table 2: Within group comparison of pre and post 10th week intervention score of Berg Balance Score and Senior Fitness Test (mean ± SD)

Outcome measures	Group A		Group B		Group C	
	Pre	Post	Pre	Post	Pre	Post
Berg Balance Score	31.6±6.6	37.9±6.1	33.6±8.6	42. 7±7.2	29.3±6.7	41.2±6.5
Chair stands	8.1±1.2	13.4±1.5	7.6±1.1	11.7±1.1	7.7±1.5	15.5±1.8
Arm curls	8.3±1.5	13.9±1.9	8.8±1.7	14.4±1.9	8.9±1.7	16.9±2.4
2 min step test	64±4.2	88.8±7.3	61.6±5.0	93.3±10.4	61.3±6.4	99.9±7.2
Chair sit and reach test	-7.0±1.1	-4.3±1.0	-6.8±1.0	-5.2±1.1	-7.1±1.0	-3.2±1.0
Back scratch test	-7.4±1.9	-6.0±1.6	-7.3±1.5	-6.4±1.5	-7.5±-1.7	-5.0±1.7
8 foot up and go test	9.5±1.2	6.9±1.5	9.3±1.2	5.7±1.2	9.6±1.4	5.1±1.7



Graph 1: Comparison of Berg Balance Scale scores after a 10-week intervention in all groups



Graph 2: Comparison of Senior Fitness Test scores after a 10-week intervention in all groups

Discussion

This study shows that all interventions in the form of strength training (Group A), balance training (Group B) and combination of both strength and balance (Group C) were effective in improving dynamic balance of older adults over a period of ten weeks. But overall improvement was greater in combination group (Group C).

It has been already proved that balance training enhances the ability to sense the joint position in space, it improves mental and neural functioning which in turn improves motor functioning and balance [16]. It also trains central nervous system and sensory receptors to be more receptive to muscular length/tension relationships, weight shifts and range of motion. The results of the present study is similar to d study done by Joseph O. Nnodim et al. they had studied dynamic balance and stepping versus Tai Chi training to improve balance and stepping in At-risk older adults [30].

Strengthening with therabands showed marked improvement in strength because it has as a positive effect on density of bones, energy metabolism and function. Regular strength training can reverse loss of muscle tissue and weakness in the elderly [19].

Gary R. Hunter et al studied effects of resistance training on older adults and concluded that resistance training is beneficial in older adults as it increases muscle mass, strength of power, reduces the difficulty of performing daily tasks [23]. Similar results were found by number of studies which improved dynamic balance in older adults when trained with balance and strength training [28, 29, 31, 32, 33, 34, 24, 35]. Christopher J. Knerl et al carried out same for six weeks but concluded that it was not sufficient to elicit positive changes so this study was carried out with the same intervention for ten weeks and in combination and got positive results [4]. Exercises used in this study were easy to perform and the monetary and temporal cost of performing these exercises into a home exercise program is cost-effective. Practice of exercises in combination may prevent older adults from falls and related injuries.

Limitations of the present study is as we have focused only on older adults age between 60-75 years, so the findings are applicable to older adults within this age group only.

Conclusion

On the basis of this study it can be concluded that combined balance and strength training over a period of ten weeks improves dynamic balance of older adult age between 60-75 years.

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