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A comparative study on the effectiveness of supervised exercise based fall prevention program in older adults

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Abstract
Background: Falls pose a serious health risk for older adults, often resulting in injury and loss of independence. Age-related declines in strength, balance, and mobility increase this vulnerability. Supervised exercise programs aimed at improving these factors have been shown to effectively reduce falls and support safer movement in this group.
Objective: To compare the effectiveness of supervised exercise program and unsupervised homebased exercise program in fall prevention in older adults in terms of fall risk and mobility.
Method: A total of 60 elderly participants, all aged above 65 years, were recruited for the study and randomly assigned into two equal groups: Group A and Group B. Group A received a supervised exercise program conducted under the direct guidance of a trained professional. Group B was provided with an unsupervised exercise program, delivered verbally through instructions, and participants were asked to perform the exercises independently. The intervention for both groups was carried out over a period of 8 weeks.
Design: This was a comparative study.
Result: 60 participants were studied overall (Supervised Exercise group A, n=30; Home Exercise group B, n=30). From pre- to post-intervention, both groups exhibited notable gains in mobility (TUG), balance (POMA) (all $p < 0.01$). Between-group studies found that the SUPERVISED group showed a notably higher decrease in TUG scores (mean % reduction: 20.9 vs. 15.6), POMA scores (mean % INCREASE: 38.2 vs. 11.3).
Conclusion: Those who participated supervised exercise program show significant good result than the participant who participated in home exercise group in term of mobility and balance.

Keywords: Balance, falls prevention, mobility, older people, supervised exercised program

Introduction

When a "fall" occurs, a person is left with an unintentional loss of balance in touch with the ground or a different surface, such as a step or chair [1]. Falls are a frequent and complicated geriatric illness that results in significant mortality, morbidity, decreased function, and early placement in nursing homes. Due to the numerous contributing causes and predisposing risk factors associated with falls, it is a tough clinical problem to diagnose, treat, and prevent them. The initial sign of a severe issue may be a fall (In Postural hypotension, cardiac arrhythmia, and infection can all be signs of a long-term illness, such as parkinsonism, dementia, or diabetic neuropathy, or they can just be indicators of the progression of typical age-related changes in eyesight, walking, and strength Falls are extremely common among older adults [2]. Each year about one out of three people older than age 65 years who is living in the community falls; this rate increases with advanced age and is higher among people who are living in institutional settings. Falls cause considerable mortality and morbidity. Over 50% of falls among the elderly result in at least some minor injury, according to a community-based study. The fracture of hip was found to occur in up to 2% of falls, while other fractures (in the arm and pelvis) could occur in up to 5% of falls. Serious injuries (head and internal injuries, lacerations) could occur in up to 10% of falls [3] A fundamental life skill is having a good balance, which relies on the interaction of several sensory, motor, and integrative systems. In order to deal with the diverse and ever-changing environmental challenges, balance depends on input from eyesight, peripheral sensation, the vestibular sense, muscular strength, neuromuscular control, and reaction time. As people get older, the function of these systems gradually declines, raising the risk of falls. Sensory loss is a growing public health issue as our population ages. Falls can cause physical injuries such bruises, hematoma, fractures, and even brain damage or other secondary issues, as well as a drop in physiological functions. Additionally, weaker muscles can cause further falls. Even though falls may not always result in severe bodily injury, they can limit everyday tasks due to persistent discomfort Therefore, the study of the physiological systems necessary for balance is of the greatest importance since this knowledge can supplement and guide the multidisciplinary evaluation and management of older individuals who fall [4]. According to the previous researches causes of falls in elder due to Accident and environment related is 31%, Gait and balance disorders or weakness is 17%, Dizziness and vertigo is 13%, Drop attack is 9%, Confusion is 5%, Postural hypotension is 3%, Visual disorder is 2% [5]. The age-related changes in older persons occur in the nervous system for example, the neurological system, which includes issues with hearing and vision, as well as a decrease in proprioceptive and vibratory perception poor positional control, modified gait, and greater sway. These modifications alone might not be the cause of a drop, but make a notable contribution to it. Issues such as a physical ailment, environment, drugs, cognitive impairment may be caused by risks. The extrinsic factors that are the contributors for fall are poor lighting and glare from the lamp, poor or no personal aid equipment, unfavorable flooring (e.g. Loose carpets uneven and slippery floors, low lying objects), obstacles (e.g. electrical cords, low lying furniture, steps.) slippery shoe wares. Some of the causes of falls are because situational factors i.e. walking while talking, being distracted by multitasking, failing to notice environmental hazard (e.g. a curb or step.) and rushing to bathroom (especially at night) rushing to answer the telephone. Physical activity is widely recognized for its numerous health advantages among the elderly. The possible benefits of exercise in enhancing cardiovascular physiology, reducing the risk of falls, and boosting cognitive abilities. The aging process is linked to increased stiffness of blood vessels and a reduction in ventricular compliance. Both aerobic and resistance training have demonstrated positive effects on cardiovascular health by altering traditional risk factors and enhancing the heart's exercise capacity. Exercise regimens have been proven to help prevent falls, although no specific type of exercise or training program is singularly effective. In older individuals experiencing mild cognitive impairment or dementia, both aerobic and resistance training have been correlated with improvements in cognitive function. Additionally, exercise may lead to enhancements in other areas, including mental health and social interaction. While frail elderly individuals may face limitations in their ability to engage in certain exercise programs, they can still benefit from adaptations that prioritize improvements in daily functioning and strengthening [6]. At the conclusion of the 1980s, Frontera *et al*. (1988) indicated that a rigorous resistance training program resulted in an enhancement of strength in the quadriceps muscles of older men aged between 60 and 72 years, which was also associated with an increase in muscle fibre size. Since that time, an increasing number of studies each year have continued to highlight the advantages of resistance training for older individuals, including those over 90 years of age. Resistance training programs are founded on the overload principle, which posits that muscles exercised near their force-generating capacity will experience strength gains (McArdle *et al*. 1996). The term 'exercise session' denotes the period allocated for training. The frequency refers to the number of training sessions conducted each week. The fundamental unit of a resistance training session is the repetition, which, for a specific training movement, involves completing a full cycle from the starting position, through the end of the movement, and returning to the start. When a series of repetitions is performed, this is referred to as a set. Volume is generally calculated as the product of repetitions and sets (Fry and Newton 2002). Intensity pertains to the relative load or resistance that the muscle is working against, typically expressed as a percentage of the maximum weight that can be lifted once, known as the one-repetition maximum (1-RM). In the older demographic, these programs exhibit a structure similar to those followed by younger individuals. The numerous issues that emerge from diminished cognitive function necessitate a healthy aging process to prevent such decline from leading to health complications in the elderly, including the heightened risk of developing dementia, which is indicative of poor cognitive function (Klimova *et al*., 2017). Cognitive function is intricately linked to bodily mobility, particularly in terms of walking speed, where the act of walking encompasses the interplay between cognitive and motor functions. Variations in walking speed, whether slow or fast, can serve as indicators of cognitive decline or motor abilities, which correlate with an increased mortality risk among the elderly (Barnes, 2015). Physiotherapists play a crucial role in delivering services aimed at enhancing cognitive function. One effective strategy for improving cognitive abilities is the implementation of tandem walking training (Quigley *et al*., 2020). Tandem walking exercises serve both as a test and a training method, requiring the heel of one foot to touch the toes of the other in a straight line [7]. This exercise aims to strengthen the proprioceptive system and is a technique for managing body posture and movement, facilitated by cognitive engagement and the coordination of trunk muscles, lumbar spine, pelvis, hips, abdominal muscles, and extending down the ankle. All are a leading cause of injury among older adults, making prevention strategies crucial for maintaining independence and quality of life. Exercise programs—both supervised and unsupervised play a pivotal role in reducing fall risk by enhancing strength, balance, and mobility [8]. Supervised exercise programs, often conducted in group settings, provide structured routines with professional oversight. These programs have been shown to significantly reduce the incidence of falls and related injuries among community-dwelling older adults. The presence of trained instructors ensures proper technique, progression, and motivation, which can lead to better adherence and outcomes. On the other hand, unsupervised or home-based exercise programs offer flexibility and convenience, making them accessible to those who may have mobility or transportation challenges. While these programs can improve balance and strength, their effectiveness often depends on the individual's commitment and ability to perform exercises correctly. Both supervised and unsupervised exercise interventions have their merits in fall prevention among the elderly. The choice between them should be tailored to the individual's health status, preferences, and resources, ensuring the selected program aligns with their needs to effectively reduce fall risk [9].

Material and Methods

1. Study design and sample size

A comparative study was conducted to evaluate the effectiveness of supervised exercise-based fall prevention program in older adult having aged above 65 years in a rural region of Maharashtra, India. The sample size was determined using Raosoft software at a 90% confidence level with a 5% margin of error, resulting in 60 participants. These participants were recruited through non-probability convenience sampling and equally divided into two groups: Group A (n=30) and Group B (n=30). Considering the rural setting and logistical constraints, convenience sampling was chosen for feasibility. The study spanned over six months, during which the effects of the interventions were systematically assessed.

2. Consent and Ethical approval

The Institutional Ethical Committee of RJS College of Physiotherapy, Kopargaon, approved the study (Approval No.: RJS/IEC/2024/09). Before participation, all individuals provided written informed consent, and enrolment was carried out based on predefined inclusion and exclusion criteria.

3. Selection criteria

The study will include older adults aged 60 years and above, both male and female, who are at risk of falls. Participants must present with a score of 19 or higher on the Fall Efficacy Scale-I, indicating a fear of falling that may affect their daily activities. In addition, individuals with a previous history of falls will be considered eligible, as they represent a population with increased vulnerability. These criteria ensure the study targets those most likely to benefit from fall-prevention interventions. Older adults below the age of 60 years will be excluded from the study, as the focus is on individuals considered elderly. Participants with congenital deformities that may interfere with mobility or assessment will not be included. Additionally, older adults with impaired vision, which independently increases fall risk, will be excluded to minimize confounding factors. Those with a recent fracture will also not be considered eligible, as their condition could interfere with participation and compromise the safety or accuracy of study outcomes.

4. Outcome Measure

The outcome measures used in the study included the Time Up Go (TUG) for balance, The Performance Oriented Mobility Assessment (POMA) to assess the mobility. These standardized tools were administered pre- and post-intervention to determine the effectiveness of the physiotherapy programs.

5. Procedure

Ethical approval was obtained from the relevant institutional review board prior to the initiation of the study. Informed consent was secured from all participants after a thorough explanation of the study's purpose, procedures, potential risks, and benefits. Participants were selected according to predefined inclusion and exclusion criteria to ensure their suitability and safety for the study. Eligible participants were then randomly assigned to one of two groups: Group A, which received a supervised exercise program, and Group B, which followed a structured unsupervised home exercise program. Both groups were provided with the same physiotherapy exercises, and the interventions were implemented over an Eight-week period.

Group A – supervised group

Group A participated in a supervised exercise program conducted over 8 weeks, with sessions held 2 to 3 times per week and personally supervised to ensure safety, correct technique, and adherence. Each 35-minute session included a 5–10-minute warm-up, 20–25 minutes of main exercise, and a 5–10-minute cool-down period. The 30 participants were divided into 6 subgroups of 5 for optimal interaction. The program involved resistance training with Thera bands targeting major muscle groups and progressive functional balance training, including tandem walking, straight leg raises, single-leg balance, and marching in place. Exercises were progressively modified based on participants' abilities and improvements, focusing on enhancing muscular strength, postural control, and functional balance to maximize benefits while preventing injury.

Group B – unsupervised exercise program

Participants in Group B were assigned to an unsupervised exercise program where the exercise protocol was explained verbally once at the start, with no direct supervision or ongoing guidance during the 8-week period. Each session lasted 35 minutes and was structured into three parts: a 5–10-minute warm-up, approximately 20–25 minutes of main exercises including resistance training and progressive functional balance training, followed by a 5–10-minute cool-down period. This approach relied on participants adhering independently to the prescribed regimen without in-person oversight.

Participants were given the following interventions:

The intervention begins with a 5 to 10-minute warm-up period designed to prepare the body for exercise by increasing blood flow and reducing the risk of injury. This is followed by resistance training using TheraBand's, which targets muscle strengthening through controlled movements that allow for gradual increases in intensity. Subsequently, participants perform progressive functional training exercises such as tandem walking—where the heel of the stepping foot is placed directly in front of or touching the toes of the supporting foot—marching in place, standing next to a chair or counter for support if needed, lifting each knee high toward the ceiling, and single-leg balance exercises, where the participant stands on one foot with the other knee slightly bent, aiming to maintain this position to improve stability and postural control**.**

Results

A total 60 participant data was analysed which are selected according to inclusion and exclusion criteria for Supervised group (n=30) and home Unsupervised group (n=30).

1. TUG Comparison

[Within group analysis using paired Wilcoxon Test]

- **Supervised Group**

Table: - 'z' value 4.795 is significant ['p'<0.01]. This shows that mean TUG score differs significantly between pre and post Tests. From table it can be observed that mean TUG score in the post Test 14.27 is less than that of Pre Test score 20.90. Hence the intervention used in supervised group decreases the TUG score.

- **Unsupervised Group**

Table: - 'z' value 4.804 is significant ['p' < 0.01] This shows that mean TUG score differs significantly between pre and post Tests. From table it can be observed that mean TUG score in the post Test 18.37 is less than that of Pre Test score 21.87. Hence the intervention used in Unsupervised group decreases the TUG score.

[Between Group Analysis using unpaired Mann Whitney Test]

Table: - 'z' value 6.754 is significant ['p' < 0.01] This shows that mean % reduction in TUG post test score differ significantly between group supervised and group unsupervised. From table, it can be observed that mean % reduction in TUG post test score in group supervised [31.72] is greater than that of group unsupervised [16.00]

Hence the intervention used in group supervised is good in reducing the TUG score.

2. POMA Score Comparison

[Within group analysis using paired z- Test]

- **Supervised Group**

Table: - 'z' value 4.821 is significant ['p' < 0.01] This shows that mean POMA score differs significantly between pre and post Tests. From table it can be observed that mean POMA score in the post Test 12.60 is more than that of Pre Test score 9.23. Hence the intervention used in supervised group increases the POMA score.

- **Unsupervised Group**

Table: - 'z' value 4.817 is significant ['p' < 0.01] This shows that mean POMA score differs significantly between pre and post Tests. From table it can be observed that mean POMA score in the post Test 10.33 is less than that of Pre Test score 9.33. Hence the intervention used in supervised group increases the POMA score

[Between Group Analysis using unpaired Mann Whitney Test]

Table: - 'z' value 6.028 is significant ['p' < 0.01] This shows that mean % reduction in POMA post test score differ significantly between group supervise and group un supervise from table. It can be observed that mean % changes in POMA post test score in group supervise [36.51] is greater than that of group unsupervised [10.71]

Hence the intervention used in group supervise is good in increasing the POMA score.

Within group Pre and post test

Comparison of pre-test and post-test scores of TUGS by paired sample Wilcoxon test or dependent t test

Table 1: comparison of pre-test and post-test score of TUGS

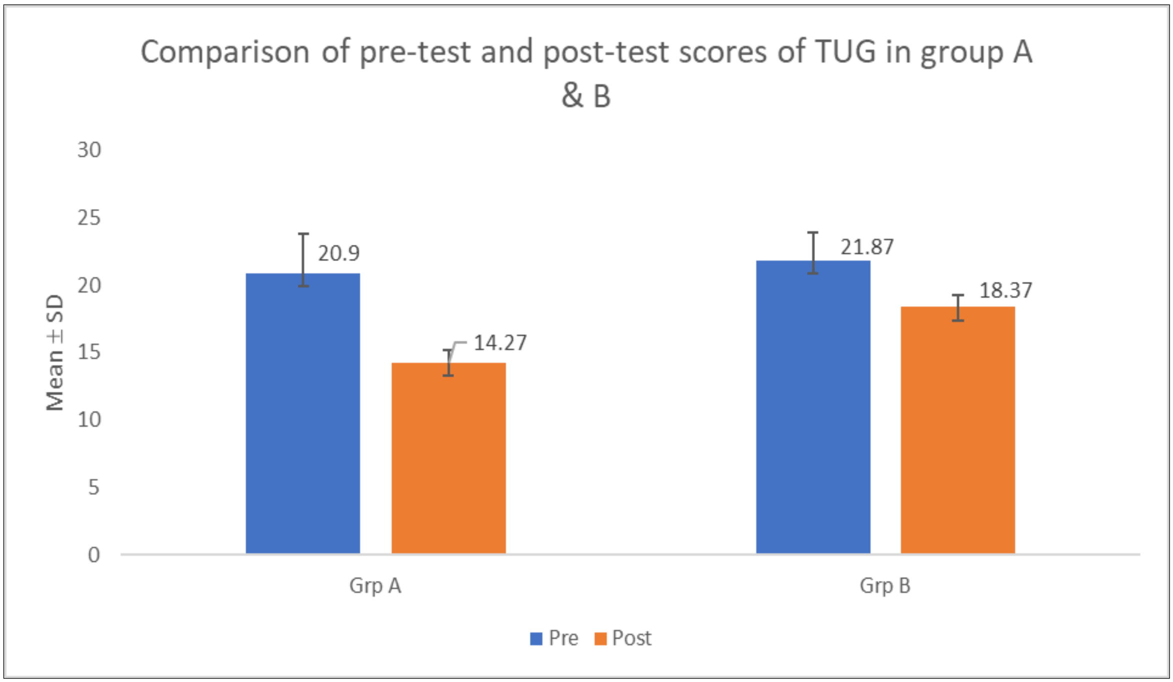
Groups	Time	Mean	SD	Mean Diff.	SD Diff.	% of change	Effect size	z-value	p-value
Grp A	Pre	20.90	2.93	6.63	2.50	31.72	2.66	4.795	0.001
	Post	14.27	0.87						
Grp B	Pre	21.87	2.06	3.50	1.59	16.00	2.20	4.804	0.001
	Post	18.37	0.93						

Within group Pre and post test

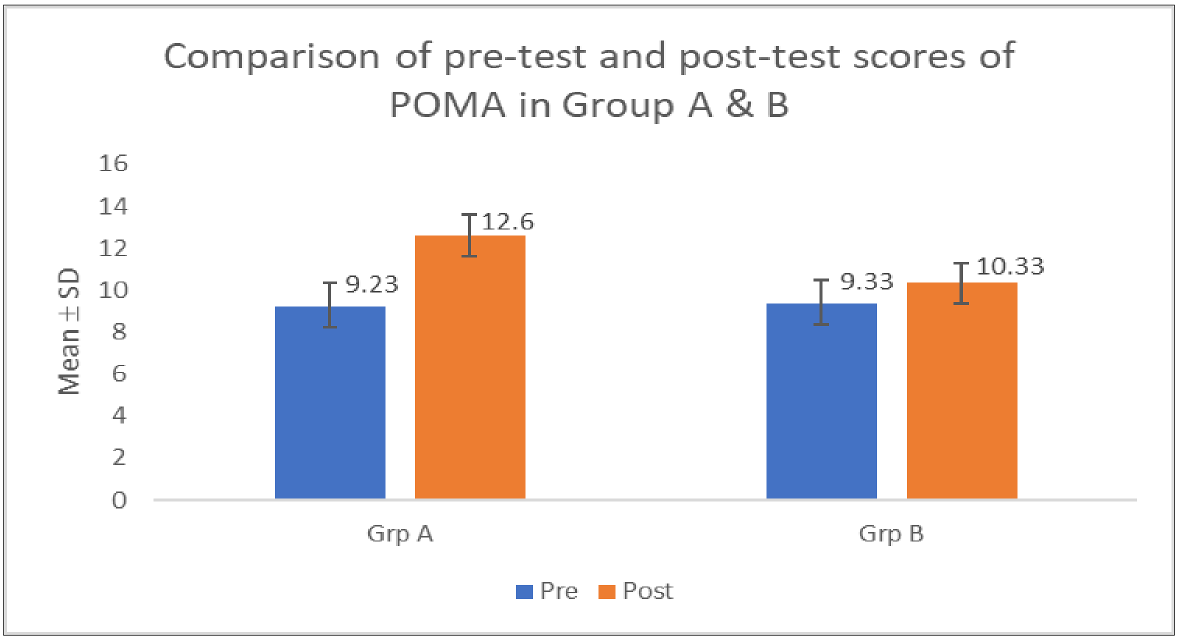
Comparison of pre-test and post-test scores of POMA by paired sample Wilcoxon test

Table 2: comparison of pre-test and post-test score of POMA

Groups	Time	Mean	SD	Mean Diff.	SD Diff.	% of change	Effect size	z-value	p-value
Grp A	Pre	9.23	1.14	3.37	1.30	36.51	2.59	4.821	0.001
	Post	12.60	0.97						
Grp B	Pre	9.33	1.15	1.00	0.53	10.71	1.90	4.817	0.001
	Post	10.33	0.92						



Graph 1: TUG comparison of pre-test and post taste



Graph 2: POMA comparison of pre test and post test

Discussion

This comparative study evaluated the effects of supervised versus unsupervised home-based exercise programs on fall prevention in older adults aged above 65 years. Falls pose a significant global health concern due to their association with morbidity, mortality, and institutionalization among the elderly, primarily caused by age-related declines in mobility, balance, and strength. The study found that both exercise modalities led to significant improvements in mobility and balance, measured by Timed Up and Go (TUG) and Performance-Oriented Mobility Assessment (POMA) scores, respectively. However, the supervised group showed substantially greater improvements, with a 31.72% mean reduction in TUG scores and a 36.51% mean increase in POMA scores, compared to 16.00% and 10.71% respectively in the unsupervised group. Statistical analyses confirmed the superior clinical effectiveness of supervised programs over unsupervised ones.

Research by Lacroix and Hortobagyi further supports these findings, indicating that supervised balance and resistance training programs result in greater enhancements in balance and muscle strength or power among healthy older adults compared to unsupervised routines. The benefits of supervision are dose-related, with additional supervised sessions yielding more significant gains in steady-state and proactive balance as well as muscle performance. These advantages are attributed to the structured oversight that professional supervision provides, including ensuring exercise safety, correct technique, personalized progression, and enhanced adherence. Although unsupervised programs offer flexibility and convenience, the lack of ongoing guidance may limit exercise quality and overall clinical benefit.

In summary, supervised exercise programs offer critical advantages by providing regular monitoring, motivational support, and social interaction, all of which contribute to better outcomes in strength, balance, and confidence—key factors in fall risk reduction. Despite the constraints of some studies, evidence advocates prioritizing supervised interventions in community and clinical settings to maximize functional improvements and independence in older adults. For those unable to access supervised care, structured education and periodic follow-up in home exercise regimens are recommended to enhance adherence and effectiveness. Policymakers are encouraged to invest in scalable supervised exercise programs as an essential public health strategy for fall prevention.

Conclusion

This study underscores that supervised exercise programs provide significant advantages over unsupervised home-based interventions in improving mobility and balance, thus effectively reducing fall risk among older adults. Adoption of these programs is essential for promoting independence, safety, and well-being in the geriatric population, with potential to reduce healthcare costs associated with falls.

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