

## Physical Therapy Exercises To Reduce Fall At Home: Literature Review

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### ABSTRACT

**Background:** Falls are the leading cause of morbidity and mortality in elderly individuals. With growing age there is a decline in physical function, including decreased mobility, strength and balance. Physical Therapy plays a vital role in preventing falls using education and exercises. The best exercises to prevent falls are yet to be determined.

**Objective:** This article reviews the risk of falls at home among the elderly population and discussed various physical therapy (PT) interventions for fall prevention.

**Methods:** A literature review was performed using keywords like falls, physical therapy exercises and home exercises on databases like PubMed, Google scholar, physical therapy journal and bmj open.

**Result:** It discusses various physical therapy (PT) interventions, such as strength, balance, and gait training. The author highlights all the interventions in detail, along with their limitations and corresponding modifications.

**Conclusion:** Finally, it concludes that a thorough assessment and individualized PT program consisting of all the discussed interventions is the most effective form of treatment.

**Keywords:** Falls, exercises, physical therapy, Otago.

### INTRODUCTION

Falls are the leading cause of injury and mortality in older individuals. Falls can result in some debilitating injuries like hip fractures and head trauma. Studies show that falls are a leading cause of Traumatic Brain Injury (TBI) and in hospital mortality.<sup>2</sup>

Quality of life in older individuals is significantly affected by falls. A fall can also reduce confidence in an elderly person, causing them to be less mobile and leading to further complications.<sup>3</sup>

Physical Therapy (PT) interventions have been shown to reduce the risk and rate of falls in older individuals.<sup>4</sup> Preventive exercises, especially patient-specific exercise programs, result in fewer falls and an improved quality of life.<sup>5</sup>

### REVIEW OF LITERATURE

#### Al-Aama, T. (2011) Review Article

This review discusses falls in the elderly population, its prevalence, risk factors and prevention strategies. The author emphasizes intrinsic and extrinsic factors affecting falls and discusses most effective multifactorial interventions for prevention.

#### Fu et al. (2017) Cohort Study

In this study the author uses the national database and identifies fall risk factors such as comorbidities and injury severity. It investigates fall predictors and mortality among elderly individuals with traumatic brain injuries.

#### Vaishya & Vaish (2020) – Review Article

This study discusses the effects of falls in elderly individuals and how it can lead to a reduction in a person's independence. Serious consequences of a fall in older adults like disability and mortality are discussed. It analyzes reasons for fall and proposes initiative-taking interventions like environmental modifications, strength and balance training to reduce falls.

#### Gillespie et al. (2012) – Systematic Review and Meta-Analysis

It is a systematic review where various interventions to prevent failures at home in older individuals are discussed. It concludes that exercise-based programs that focus on strength and balance exercises are the most effective for fall reduction.

### **Senderovich & Tsai (2020) – Systematic Review**

This study systematic review of exercises for fall prevention. It discussed and evaluated different exercises and their effectiveness in improving balance and strength. It concludes that there is a need for further research to optimize exercise protocol for elderly individuals.

### **Fujita et al. (2019) – Experimental Study**

This clinical trial study discusses the effect of a sit to stand exercise program in frail elderly individuals. 14 men and women aged between 75-88 years of age underwent a 12-week training program (3 times/week). It showed improvement in knee extension strength and ability to get up from lower surfaces, supporting the role of this exercise in fall prevention.

### **Ishigaki et al. (2014) – Systematic Review**

This systematic review discusses how lower extremity muscle strengthening exercises help reduce falls. It studies clinical trials focusing on resistance and balance training exercises. The study concluded that a combination of balance and strengthening exercises improves mobility and reduces the risk of falls in older adults.

### **Ema et al. (2017) – Experimental Study**

This study discusses the effects of home-based calf raise exercise on improving balance and reducing falls. A Randomized controlled trial (RCT) was done between 34 elderly men (73+-5 yrs). It concluded that men in the experimental group showed improvement in functional neuromuscular capacity which can protect older individuals from falls.

### **Kato et al. (2018) – Experimental Study**

This clinical trial involved 2 groups: exercise and non-exercise groups. The exercises group went through a 12-week exercise program consisting of marching in place and chair raises were performed. The study concluded that the exercise group showed significant improvement in activities of daily living and overall mobility.

### **Sitthiracha et al. (2021) – Cluster Randomized Clinical Trial**

This randomized controlled trial involved 60 elderly individuals, 30 in the control group and 30 in the experimental group. The individuals

in the experimental group went through an 8 week of progressive step marching exercise program 5 times a week. The experimental group showed significant improvement in balance and lower extremity strength.

### **Daly (2017) – Review Article**

This review article discusses exercises and nutritional strategies for preventing frailty, falls and fractures in elderly individuals. It discusses the importance of vitamin D supplementation, protein intake and resistance training in maintaining muscle function and bone health.

### **Sherrington et al. (2011) – Meta-Analysis**

This study was a meta-analysis that evaluated exercise programs aimed at reducing falls in older adults. The study concluded that high-challenged balance exercises are particularly effective and provide best-practice recommendations for implementing fall prevention programs.

### **Soto-Varela et al. (2015) – Clinical trial**

This study investigates the effects of vestibular rehabilitation on balance improvement and fall reduction. 220 individuals were randomly divided into four groups: posturography exercises, optokinetic exercises, home exercises and control group. The study discusses the importance of postural control through targeted vestibular training.

### **Verghese et al. (2010) – Observational Study**

This cohort study examines the association between neurological gait abnormalities and fall risk in elderly. 632 older adults over the age of 70 enrolled in the study. Their gaits were assessed by clinicians using a clinical gait rating scale. The author concluded that unsteady and neuropathic gait were two subtypes that predicted risk of falls.

### **Rice et al. (2025) – Randomized Controlled Trial**

This study is a RCT done over a period of 12 months on individuals over 70 years of age with at least 1 fall in the last 12 months. 344 people participated and were divided into two groups: an exercise group and standard of care group. It concluded that patients with improved gait speed in the exercise group showed improvement in risk of falls.

### **Bradley & Hernandez (2011) – Review Article**

This article reviews geriatric assistive devices and their role in fall prevention. The authors discuss mobility aids such as walkers, canes and grab bars. It emphasizes their benefits in improving mobility and reducing fall risk in older adults.

### **Yang et al. (2022) – Systematic Review**

This study systematically reviews the effectiveness of the Otago Exercise Programme in preventing falls among older adults. The study infers the ability of this program to reduce risk and fear of failure through structured strengthening and balance training.

### **METHODS**

A comprehensive literature review was performed using Google Scholar, BMJ Open, PTJ, and PubMed databases. Studies were selected using keywords, such as falls, PT exercises, and home exercise programs.

### **RESULTS**

#### **STRENGTH TRAINING:**

Multiple studies have inferred that strength training is related to fall reduction. Here, we review the effectiveness of different strengthening exercises.

#### **1. Sit to stand (STS):**

This is a simple exercise used to strengthen the lower extremity muscles, specifically the knee extensors, which are used primarily to lower and raise the body. Studies have shown an increased age-related reduction in the knee extensor musculature compared to other muscles.<sup>6</sup>

Studies have shown a significant reduction in falls with this exercise.<sup>7</sup> Sit-to-stand is also a simple exercise that a person performs in daily life, making it easier to teach and has fewer chances of errors. This exercise is cost-effective as it does not require any special equipment.

#### **Limitations:**

Although sit-to-stand exercise has some positive results and is easy to administer, it has its own disadvantages.

- STS can lead to knee pain in patients having knee related issues.

- Patients with leg weakness might have difficulty performing these exercises, which can lead to injuries.
- Heavier patients find it difficult to perform these exercises because they might not have the strength to lift their body weight.

#### **Modifications:**

The above limitations can be tackled by using modifications:

- Using arms to push up from the chair.
- A higher chair was used to reduce the amount of knee extension required to stand up.
- Partially sitting up by just lifting buttocks off the chair.

Progressive improvement in muscle strength with PT will help improve strength, allowing the patient to perform normal STS exercise.

#### **2. Calf rises:**

Calf raises are exercises that help target the gastrocnemius and soleus muscles and improve ankle Range of Motion (ROM). The rate of Force Development (RFD) is the speed at which a muscle can generate force. This is an important factor in maintaining balance.

Age-related decrement in RFD for plantarflexion motion was related to higher falls.<sup>8</sup>

Calf raises are easy to perform, do not require a tool, and can be used to improve plantar flexion strength and RFD, in turn improving mobility and reducing the risk of falls.

#### **Limitations:**

- It can be counterproductive in patients having severe balance problems.
- It can lead to knee or ankle pain if not performed correctly.

#### **Modifications:**

- To be performed with upper body support
- To be performed under supervision

#### **3. Standing Marching:**

Standing marching in place is another good exercise intervention that can improve muscle strength, balance, and gait patterns. This exercise promotes the muscles that are required while walking and involves a component of standing on one leg, challenging equilibrium, and balance.

Standing marching can be performed with different variations, making it a dynamic exercise. Studies involving Marching in Place and Chair raise protocol for 12 weeks have shown significant improvement in the Barthel index score, showing improvement in Activities of Daily living (ADL) participation.<sup>9</sup> Another modification of the standing marching exercise is the Progressive Step Marching Exercise (PSME). In this modification, step marching is performed at different angles, stepping forward and backward, and is typically coupled with music. Studies have shown improvements in balance, strength, and fear of falling in adults.<sup>10</sup>

#### **Limitations:**

- Difficult to perform without supervision, especially in patients with poor balance and reduced safety awareness.
- Difficult exercises for patients who cannot tolerate standing for a long time.
- It can be a taxing exercise for patients with cardiopulmonary problems.

#### **Modifications:**

- Can be performed with upper extremity support to make it easier.
- Amplitude of march can be adjusted to reduce stress on muscles and joints.

#### **4. Progressive Resisted Exercises (PRE):**

PRE is a type of exercise training in which a muscle or a group of muscles is exercised in different positions and against different resistances to improve muscle strength.

PRE by itself has not shown a reduction in falls in adults; however, coupled with the above-mentioned functional exercises, it has proven to be an effective way of improving strength and reducing falls in the elderly population.<sup>11</sup>

PRE is an important supplemental exercise in individuals as it can help in building patients' strength to be able to participate in functional exercises like sitting to stand, marching and calf raises. These exercise training programs can be an important starting point in Physical Therapy rehabilitation.

The above-mentioned limitations for the functional exercises can be tackled using PRE training.

#### **Limitations:**

- PRE itself has been shown to be ineffective.
- Requires tools such as resistance bands or weights to perform.

#### **Modifications:**

- Exercises can be performed in different positions as tolerated by the patient.
- Progression of the exercises can be tailored to patient needs.

#### **BALANCE TRAINING:**

Progressive balance training exercises had a greater impact on fall reduction in older adults.<sup>12</sup>

##### **1. Weight shifting:**

Side to side, front, and back weight shift as an easy exercise that challenges changing the center of gravity. These motions are commonly used in daily activities such as walking, turning, and cooking.

##### **2. Reducing base of support:**

Exercises include standing with feet together, followed by tandem standing, and progressing to a single-leg stance. These exercises challenge a person's balance by reducing their base of support. It can be further progressed by performing the exercises in different positions with eyes closed, reducing visual cues, and challenging the vestibular system.<sup>13</sup>

#### **Modifications and recommendations:**

Balance training exercises involve challenging a patient's balance, which can be a very risky exercise, as it can lead to falls in patients with poor safety awareness.

It is important to perform these exercises under supervision. Some modifications, such as the progressive use of upper extremity support (using 2 hand support progressing to 2 finger support to 1 finger support) can be beneficial.

#### **GAIT ASSESSMENT AND TRAINING:**

Gait is a complex activity involving multiple systems in the body that work together. An abnormal gait is a sign of one or more systems that do not work properly. Evaluating a patient's walk is especially important, as an abnormal weight is a predictor of fall.<sup>14</sup>

Neurological conditions such as stroke, parkinsonism, and ataxia lead to different gait



abnormalities due to muscular, neurological, and cognitive effects. Assessing these abnormalities is the key to reducing the risk of falls.

Studies show that patients with slow gait speed are at a higher risk of falls and hospitalization compared to patients with normal speed.<sup>15</sup>

#### **ASSISTIVE DEVICES(AD):**

ADs, such as walkers, canes, crutches, and wheelchairs, are commonly used by elderly individuals to improve gait patterns and reduce the risk of falls.

ADs help increase the base of support while walking and make a person more independent.<sup>16</sup>

Physical therapy plays an important role in assessing gait abnormalities, prescribing the right AD if needed, and training using interventions such as supervised strengthening,

balance, and gait training.

#### **DISCUSSION AND CONCLUSION**

The Physical Therapy discussions discussed in this article are studied to be the best exercises to help prevent falls in the adult population. No exercise by itself has not shown to be as effective as a combination of all these exercises (see Table 1: Adaptation from Otago exercise program)

Exercise programs like Otago which focus on all aspects of balance have shown to be one of the gold standard exercises in reducing risk of falls.<sup>17</sup>

Although this article highlights the most beneficial PT exercises that help reduce the risk of falls in the elderly, it is still imperative to have a thorough PT assessment and an individualized plan of care to maximize patient outcomes.

**Table 1: Adapted from Otago exercise protocol:**

Type	Exercise	Description	Progression
Warm up	1. Neck movements(Rotations) 2. Chin tuck 3. Shoulder Roll 4. Ankle movements	1. Slowly turn your head to the right and left. 2. Gently glide your head straight down (make a "double chin") 3. Roll shoulder forward and backwards. 4. Point your toes down and then pull it upwards.	
Strengthening	1. Knee extension (with ankle weights) 2. Knee flexion (with ankle weights) 3. Hip abduction (with ankle weights) 4. Sit to stand. 5. Toe rises. 6. Heel raises	1. Sit in a chair, straighten one leg out, then slowly lower it. 2. Stand tall, bend one knee, bringing your heel towards your bottom. 3. Stand straight, keep your knees straight and swing one leg out. 4. Stand up from a chair, then sit back down. 5. Stand up from a chair, then sit back down. 6. Stand tall, lift your toes off the ground, rocking back on your heels.	1. Increase weight gradually. 2. Increase weight gradually. 3. Increase weight gradually. 4. Start with using Upper extremity support and progress to no support.
Balance	1. Tandem stance 2. One leg stance 3. Sideways walking	1. Stand with one foot in front of the other, heel to toe. 2. Stand on one leg.	

	4. Backward walking 5. Tandem walking 6. Walking and turning 7. Backward tandem walking 8. Heel walking 9. Toe walking 10. Stair climbing	3. Walk sideways, stepping one foot out to the side. 4. Walk backwards. 5. Walk heel to toe. 6. Walk forward, turn around, walk back. 7. Walk backward, heel to toe. 8. Walk on heels. 9. Walk on toes. 10. Walk up and down stairs.	Start all exercises with Upper extremity support, slowly progress to no support.
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### CONFLICT OF INTEREST

I declare that I have no personal or professional conflicts of interest related to this manuscript.

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