

Effects of Lower Extremity Strengthening in the Geriatric Population and Association with Falls

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Abstract: *Falling in older age has been the most common cause of morbidity at this age. This leads to debilitating social outcomes with high and increasing economic costs. Different reasons have been studied that are associated with the elderly population and the risk of falls in general, among which balance, coordination, and strength of the lower limb are the most common. In the present study, we will try to understand the relationship between the strength of overall lower extremities in old age and its association with falls in the geriatric population. The study will also evaluate some of the commonly practiced interventions in physically active old age to maintain the strength of the lower limb and the risk of falls.*

Keywords: lower limb strength, geriatrics, risk of fall

1. Introduction

A fall is an unintentional, uncontrolled response of a person coming down to rest on any hard surface or ground due to imbalance or disturbance in the base of support or any internal or external force that is directed toward a lower level of the center of gravity. As studied, this is most commonly encountered in the old age population. It is also well cited by many researchers that “falls are a significant problem in the geriatric population and that treatment and complications result in high treatment and rehabilitation costs” (Ganz et al., 2007). This also impacts their physical, mental, and social health. There is also fear of falls in the geriatric population. Fear of falling, also termed basophobia or ptophobia, is a feeling of “falling” or “fear that restricts the person from doing any activity as they think it may result in a fall.”

Different studies have cataloged different reasons that may be associated with falls and the risk of falls, among which balance, coordination, and strength of the lower limb in the aging group are widely studied. Different interventions have been published regarding the different reasons to prevent falls in geriatrics. In the present study, the researcher's objectives will be (a) to evaluate the articles that will shed more light on the association between the strength of the lower limb and fall events in the old age population, and (b) the different available commonly used interventions that explain the effects of lower limb strengthening in the geriatric population. Therefore, the aim of the present study will be to evaluate the effect of lower limb strengthening in the geriatric population and its association with falls.

2. Study Method

The present study is a short review of the topic "Effect of Lower Limb Strengthening in the Geriatric Population and Its Association with Falls." The study is based on evaluating English - language research articles published in indexed journals like Scopus and MED - LINE under the keywords old age, geriatric population, lower limb strength, interventions to fall prevention, accidental falls, and risk of fall factors. The articles included in the research work were those fulfilling the inclusion criteria that state (1) participants

included in the study were 65 years and above, (2) source articles' participants should be institutional or community - dwelling older subjects, and (3) the study articles should mention the above keywords or studies that included preventive interventions in lower limb strength maintenance and/or increase the strength of the lower extremities. The study excluded articles before 2019. Also, studies were retrieved if muscle strength was not evaluated as a risk factor or in combination with other variables.

The maximum number of articles in close relation to the inclusion and exclusion criteria were included in the pre - selection slot. Two of the investigators independently assessed each study using the selection criteria. To minimize bias in the selection of studies, photocopies of the articles were provided after removing all identification (such as journal, authors, institution name) and results information. Both outcomes were compared, and disagreements were resolved by consensus. Data was collected from each paper for study characteristics. For easy translation of the notes, the raw data was filed in table format and then evaluated by the primary author. Measurements of muscle strength, pre - intervention and post - intervention in some studies were considered for comparison and better understanding. Extraction of results was done on a single table for explanation in brief.

3. Results

During the initial search, the number of studies totaled about 650. After repeated review of titles and abstracts, 510 relevant articles were considered to be evaluated by two independent investigators. Fifty articles were more closely aligned with the aimed discussion. Out of which, 20 were taken for the final list study after cross - checking for its acceptance following the study's inclusion and exclusion criteria manually by the primary author. From the final list, 10 studies did not have the required data available for discussion input. Therefore, there were 10 independent studies that were finally tabled in ground results.

As the objective was specific to the strength of the lower limb, adjusted studies had to be considered. Sex, height, chronic

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illness, and physical activity were highly correlated in some studies with muscle weakness. Studies that had lower limb strength as a discussion part but along with other factors and comorbidities that could not clearly specify the association or relation with the fall or risk of falls were excluded.

4. Discussion

As documented that lower extremity weakness is a clinically important and statistically significant risk factor for falls (Moreland et al., 2004), different studies aimed to see the effects of different interventions. The present study had an objective to have a short review of different physiotherapy interventions that have shown significant changes in the effects of lower limb strength and the occurrence of falls in the geriatric population. The studies also aimed to state the association between lower limb strengthening and falls in the geriatric population. The effect persists in a sensitivity analysis of 10 articles, including only studies reporting adjusted results and on 65 years and above institutionalized or community - dwelling adults.

History and data suggest 1/3rd of geriatrics over 65 experience falls at a time that gives a lifetime impact (Campbell et al., 1990). As stated, prior, the most common reasons underlined are due to decreased lower limb strength, balance, and coordination functions, overall due to limited activities and mobility, or maybe due to combined disorders or disabilities. Other factors can be other sensory system impairments like vision, sensory, psychological, neurological, etc., of which we will explore more about the strength of the lower extremity and its association with falls in the geriatric population.

Before understanding the association, it is essential to know the tests related to the strength of the lower limb. The widely accepted tests are the Timed Up and Go test (TUG), the Chair Stand Test, and the Fall Risk Test protocol of the Balance System SD (Podsiadlo & Richardson, 1991). Isokinetic dynamometers are also valid tools that are used in many studies to record the strength of the muscle (Biodex Medical Systems, 2004).

Different studies available on the association of lower limb strength and falls in the geriatric population suggested that postural stability is one of the important factors regarding strength and falls. As there is development in age after 65 years, there is a decline in various systems anatomically and physiologically that is said to be natural. The same applies to muscle strength. As the age increases, muscle strength decreases. This reduces the function and activities of the muscle, which is very important in day - to - day activities, as in the lower limb for balanced standing or during dynamic mobility. It is recorded that 1.8 to 2.0% of muscle strength can be reduced per year after 65 years, and so does muscle power (Goodpaster et al., 2006). Therefore, lower limb strength is clinically important in investigating falls and the risk of falls (Muir et al., 2010). Some systematic studies also demonstrated that weakness of the lower limb or decrease in strength of the lower limb when assessed for risk of falls shows a significant relationship between lower limb strength and falls in community - dwelling older adults (Moreland et al., 2004).

Different studies suggested that muscle strength of hip abductors, adductors, flexors, and knee flexors, extensors, and plantar flexors significantly play a role in adjusting the parameters of gait, which, when reduced with strength, impacts more accidental falls. Tests like the sit - up and go test can predict the fall when the grip strength and hip strength are decreased along with hip, knee, and ankle mobility (Buchner et al., 1996). Hip strength is directly linked with a higher risk of fall (43%) and fracture in the hip region. This also affects control in postural sway during mobility. Decrease in ankle mobility had difficulties in tandem gait walking. Gait with a narrow base stance with mediolateral sway in older people will have a recurrent fall history. A study suggests that the greater the stability index, the greater the risk in balance dysfunction that will lead to falls (Lord et al., 1994). It demonstrated that higher the strength of the lower extremity, control on balance, activity, and mobility is better, giving less risk of falls (Carter et al., 2002).

Various studies also suggest that the decrease in lower limb strength is not alone. The association of decreased hand grip and spinal muscle stiffness also plays a negative role in keeping lower limb strength as required, leading to postural deformities that increase the risk of falls in multifactorial ways. Restrictions in joint mobility due to the decrease in lower limb strength also increase the risk of falls. Studies reported that activities to maintain posture and balance during gait get impaired due to a decrease in lower limb strength. Ankle joint strategies also play a role in adjusting balance and posture, which, when lower limb strength decreases, also decreases and increases the risk of falls. Studies also suggest that an increase in lower limb fatigue, especially ankle muscle fatigue, increases difficulties in clearing the ground during the swing phase and impaired balance during the stance phase, leading to an increased risk of falls (Helbostad et al., 2007). Gait and balance control requires adequate muscle strength, which, when compromised, increases the risk of falls in the elderly. The review states that the decrease in muscle strength and a decrease in function due to various reasons in the geriatric population are statistically significant factors in predicting falls. A systematic study stated that the strength of knee extensors and hip abductors is closely associated with falls in community - dwelling older adults. The lower the strength of the lower limb, the higher the risk of falling (Horlings et al., 2008). Strengthening of the lower limb with available exercise protocols demonstrated a decreased risk of falls and the negative association between lower limb strength and falls in community - dwelling older adults (Pijnappels et al., 2008).

Therefore, it is well cited that lower limb muscle strength is clinically and statistically important in the investigation of falls and the risk of falls in community - dwelling older adults (Moreland et al., 2004).

5. Interventions

Different studies have been carried out for decades and cited many outcomes for intervention to decrease the risk of falls. Studies have reported positive changes in the decrease of fall risk factors in elderly people. Various exercise protocols and

training programs have been carried out to prevent the risk of falls in the geriatric population.

Balance training exercises and strength training exercises for the lower limb have demonstrated significant improvement in mobility, balance, and gait with the impact of a decrease in risk of falls (Sherrington et al., 2011). Different exercise programs like Otago Exercise Program, fall management exercises, ankle, and hip strengthening exercises, and proprioceptive neuromuscular facilitation exercises demonstrated significant positive changes in muscle power and muscle strength of the lower limb. In relation to this, there are effects of lower limb muscle strengthening and endurance training along with balance training. The intervention program demonstrated significant improvement in strength, balance, and coordination, which reduces the fall risk (Gschwind et al., 2013).

Different systematic studies demonstrated progressive resistance training on lower limb strength and balance. They had significant improvements in lower limb strength and balance in intervention groups compared to control groups (Latham et al., 2004). There were progressive resistance exercises given for 12 weeks. The groups in the intervention program were given 2 sessions per week, including exercises for all lower limb muscles. Another control group was given only general group activities. After 12 weeks of progressive resistance exercise program intervention, they had a significant improvement in the strength of the lower limb muscles, and the balance was also significantly improved (Latham et al., 2003).

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