

## **5 EFFECTS OF LOWER LIMB EXERCISE IN OLD AGE GROUP IN BERG BALANCE SCORE**

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### **ABSTRACT**

Falls are a relatively common event in older people. Approximately 30% of individual's over 65 years of age fall at least once a year, and about half of those do so recurrently. Fall related injuries and death in older people are a major health care problem worldwide, with the numbers continuing to rise. Thus, falls prevention in older people remains a major health care priority. In the old age group muscle weakness, joint stiffness, proprioceptive deficit is very common which leads to imbalance and ultimately increasing the risk for fall. Fall itself is very hazardous for the old age group as bone density will be reduced and can cause fracture of upper limb or lower limb bone. So it is highly advised that weight bearing exercise like one leg standing, tandem walking as well as functional strengthening exercises like forward lunges, mini squatting and stepping exercises can be very helpful for the older individual which increases the balance and strength in the lower limb and reduces the chances of fall.

### **1: INTRODUCTION**

Falls are a relatively common event in older people. Approximately 30% of individual's over 65 years of age fall at least once a year, and about half of those do so recurrently. Fall related injuries and death in older people are a major health care problem worldwide, with the numbers continuing to rise. Thus, falls prevention in older people remains a major health care priority.

**FEAR OF FALLING (FoF)**, defined as a disabling symptom of impaired mobility among frail older people, is common in community of older adults. It has been associated with depression, functional limitations, and gait impairments.<sup>1</sup> FoF has been

identified as one of the greatest fears experienced and felt by the older individual in the current era.<sup>2</sup>

Delbaere et al<sup>3</sup> discussed the “vicious cycle” of FoF: those with FoF exhibit decreased activity and participation in their environment, leading to further decreases in strength and balance, thus placing them at greater risk for falls and increased FoF.

Development of FoF has been associated with worsening in performance of activities of daily living, mobility, mood, life satisfaction, and general health<sup>4, 5</sup>. Further, it has been shown to limit participation within roles and diminish social functioning, self-efficacy, and quality of life.<sup>6, 7</sup>

Rapid increase in the number of older people is a global phenomenon. Developing countries are graying as the elderly population is growing much faster than expected. An unprecedented increase in human longevity was one of the most spectacular events of the 20th century. The resultant population aging with all its ramifications is more evident in most parts of the world.<sup>8</sup>

Aging is a universal phenomenon. India is the second largest country in the world, with 72 million elderly persons above 60 years of age as of 2001.<sup>10</sup> World health organization (WHO) uses 60 years of age and older as the general definition of an older person. However an elderly can be defined in three main categories 1) chronology 2) change in social role (i.e. change in work patterns adults status of children and menopause) 3) change in capabilities (i.e. change in physical characteristics).<sup>9</sup> Aging is a cumulative and continuous process taking place in human from conception to death. This age group is classified as young old group between 60-75 years, middle old group between 75-85 years; old old group is older than 85 years of age.<sup>11</sup> With advancing age, structural and functional deterioration occurs in most physiological systems; this age related physiological changes affect a broad range of tissues, organ, systems and functions, which cumulatively can impact activities of daily living (ADL) and the preservation of physical Independence in older adults.<sup>12</sup>

According to Bowen RL, Atwood CS 2004 human body composition changes with age, but the causes and consequences of these changes are only partly understood. One such serious and a silent problem with which an elderly suffers is frailty syndrome. Rockwood et.al described the concept of frailty as “a multidimensional syndrome which involves loss of reserves (energy, physical activity, cognition and health) which gives rise to increased vulnerability.”<sup>14</sup> Subjects with the frailty syndrome have increased risk of adverse events such as death, disability, and institutionalization.<sup>13</sup> Loss of muscle strength in old age is a prevalent and disabling condition. Muscle strength declines with age such that, on average the strength of people in their 80 years is about 40 percent less than that of people in their 20 years. Muscle weakness particularly of the lower limbs, is associated with reduced walking speed, increased risk of disability and falls in older people.<sup>16</sup>

This decline that is increasingly recognized to have important consequences in old age was given the name “sarcopenia” by Rosenberg (1989).<sup>17</sup> Sarcopenia is a syndrome characterized by progressive generalized loss of skeletal muscle mass and strength, usually accompanied by physical inactivity, decreased mobility, slow gait speed and poor physical endurance which are also common features of the frailty syndrome.<sup>14</sup> Sarcopenia is an important independent predictor of disability linked to poor balance, gait speed, and falls thus, leading to functional disability.<sup>13</sup>

Effect of aging and the subsequent loss of strength have a pronounced effect on the capacity of older people to lead viable and independent lives. The deterioration in functional capacity can decrease the ability to perform common activities of daily living in the older population. A recent study in the United States showed that above the age of 65, 28% of the men and 66% of the women could not lift objects weighing more than 4 kg, so, the viability of the musculoskeletal system definitely declines with age.<sup>18</sup> Prevalence of fall and fear of falling is potentially increasing with age, of the medical conditions predisposing to falls in elderly, musculoskeletal problems ranks first followed by others.<sup>15</sup> Disability in Activities of Daily Living (ADL), such as bathing, dressing,

walking which are the essential activities that a person needs to perform to be able to live independently.<sup>20</sup> Disability can be identified accurately through responses to a wide variety of questions about the ability to perform activities ranging from basic self-care to household activities.<sup>21</sup> Disability in the older population, and the attendant need for informal and formal care, will increasingly affect older people, their families, and the health care system as the population continues to age.<sup>20</sup>

The performance of all activities of daily living requires good balance control while at rest or when moving from one position to another. Maintenance of balance requires the coordination of sensory, neural and musculoskeletal systems. Many of these systems undergo deterioration as people age. This has the potential to affect balance, restrict safe mobility, increase the likelihood of a fall and adversely affect quality of life. Therefore the assessment of balance with older people is important to direct appropriate interventions to improve balance performance and to monitor changes in balance over-time.<sup>22</sup>

Various approaches to measure balance have been developed. Questionnaires such as Rivermead Mobility Index and the Activities Specific Balance Scale provide self-report information regarding functional status. Laboratory measures such as computerized force platforms provide accurate measurements of postural sway. Functional performance-based tests such as the Berg Balance Scale and the Timed Up and Go Test may be defined as tests which objectively measure a person performing balance or walking tasks. An advantage of functional balance tests is their practicality for assessment in a variety of settings because of their low cost, lack of complex equipment and time efficacy.<sup>22</sup>

There are vast numbers of functional balance assessment tests. To measure the risk of fall in older people around 17 functional outcomes, like Functional Reach Test (FRT), Berg Balance Scale (BBS), Lateral Reach Test (LRT), Performance Oriented Mobility Assessment (POMA), Fullerton Advanced Balance Scale (FAB), Timed Up and

Go Test (TUGT) Physical Mobility Scale (PMS), Balance Screening Tool (BST) etc are available. Of the numerous functional balance tests available, only the TUGT, BST, BBS and FAB have established reliability and concurrent validity with community dwelling older adults. TUGT and BST provide efficient screen of a person's balance abilities, however do not offer enough detail to determine the source of impairment. The FAB scale may be more applicable for older people living independently, however further research with higher methodological quality is required to establish its reliability and validity. While being the most rigorously developed functional assessment balance test, the BBS may be more appropriate for use for frail older adults due to limited assessment of dynamic balance.<sup>22</sup>

It has been shown that individuals prone to falls possess lesser strength and power in their lower extremity as compared to those without a history of falls. It has been shown that 6 week of progressive resistance training program is likely beneficial for improving static and single leg stance balance in untrained older adults.<sup>24</sup> so, in geriatric population functional disability is the major problem. The evaluation of functional disability focuses on the performance of activities and functions in different areas, among which the tasks of everyday life, and other requisitions of the day to day activity.<sup>19</sup>

The association between reduced lower extremity strength, poor mobility and functional dependence in frail elders are well known. Older person's functional mobility performance and independence can be improved by enhancing lower extremity muscle function. Hip extension, knee extension, and planter flexors are significant predictors of ambulation functions in older adults in the community. Planter flexors and quadriceps muscle accounts for 42% to 59% of variance as being important determinant of ambulation capacity in community dwelling elderly fallers. They provide stability for the weight bearing limb and allow for advancement of the swinging limb in both walking and stair climbing tasks.<sup>23</sup> so, to measure physical dysfunction power is a reliable measure of muscle performance in younger and older individuals. The significance of

impairments in muscle power has been demonstrated in studies confirming the positive association between muscle power and functional mobility tasks and the identification of peak muscle power as a strong physiological predictor of functional limitations and disability in older people.<sup>25</sup>

In 1980's it was thought that resistance training for older adults would only be beneficial for neural adaptation and that older muscles are unable to hypertrophy, however in the next decade Frontera et. al., (1988) and Fiatarone et. al., (1990) clearly established by the more sophisticated imaging techniques in their studies that older adults could achieve muscle hypertrophy with short term (8-12 week) high intensity training. Recent studies show that resistance training has remarkable beneficial effects on the musculoskeletal system including prevention and treatment of this syndrome. Studies demonstrate that regular progressive resistance training develops the strength and size of muscle and increase bone mass from young male athletes to older women.<sup>13</sup>

PRT is the most commonly used resistance therapy in older people. Progressive resistance exercise is a method of increasing the ability of muscles to generate force and improves the physical function in elder people.<sup>29</sup> A Cochrane review of 121 randomized controlled trials of PRT 2-3 times per week improved physical function, gait speed, timed get up go score, climbing stairs, balance and more importantly had a significant effect on muscle strength especially in the high intensity training group.<sup>14</sup>

Sigrid Tieback et.al., described the PRT for older hospitalized patients have an effect on functional status, there is a significant improvements in the 10m walk test, barthel index and timed get up and go test after 8 week of resistance training with 2-3 session per week.<sup>11</sup> Daily adjusted progressive resistance exercise protocol is used for the special consideration like osteoporosis, geriatric population, children and pregnant women.<sup>28</sup> The DAPRE system is a 5-RM to 7-RM (repetition maximum), 4-set system. DAPRE allows patients to exercise to their fullest potential while simultaneously accounting for daily variations in their strength levels. With excessive resistance The

DAPRE system allows for maximum strength gains to be attained in the quickest amount of time possible without endangering the patient by overloading his or her tissues and joints.<sup>29</sup> The DAPRE system provides our patients with a simple and reliable means of advancing their exercises that ensures they receive the desired benefits of the exercise without the worry that they will overload their tissues and reinjure themselves. It also provides a safety net for apprehensive patients who may be less inclined to advance their exercises due to fear of re injury. The DAPRE system is a reliable, valid, and flexible tool that can be adjusted to a myriad of patients and rehabilitation settings and is a valuable resource for rehabilitation professionals.<sup>29</sup>

Balance is staying upright and steady when stationary, such as when standing or sitting, or during movement. The loss of ability to balance may be linked with a higher risk of falling, increased dependency, illness and sometimes early death. However, it is unclear which types of exercise are best at improving balance in older people living at home or in residential care.

So it is very important to see that how far physical therapy in the form of strengthening and stability exercise is helpful to improve the balance in the older age group. So many studies have been done to find out the relationship between berg balance scale and the strength in the lower limb. However in this study the aim was to find out specific exercise and finding out its effects on the score of balance.

## **2: METHOD**

### **2.1: DESIGN:**

We have taken 6 weeks exercise programme to see the effects on BBS before and after the exercise programme.

### **2.2: PARTICIPANTS:**

All 40 participants were assessed with BBS and their score was note down. Participant were chosen from the different cities of Gujarat and given full detail regarding the BBS and how score was counted.

### **2.3: INCLUSION & EXCLUSION:**

#### **2.3.1: Inclusion criteria:**

- *Age between 50 to 75*
- *Person should be willing to participate in the study*

### **2.3.2: Exclusion criteria:**

- *Age more than 75*
- *Any associated musculoskeletal illness like severe osteoarthritis, severe ankle or hip pain*
- *Person is not willing to participate in the study*

### **2.4: ASSESSMENT:**

Each individual was assessed and instructed in detail regarding the study purpose and the procedure by the final year students of the government physiotherapy college, Jamnagar, Gujarat.

Assessment was done by the BBS. It has 14 items and each item has score from 0 to 4 so minimum score can be 0 and the maximum score can be 56. If the score is high then it indicates that the balance is good and if score is less then balance is poor.

If BBS score is less than 36 points then there is risk of fall.<sup>30</sup>

### **2.5: INTERVENTION:**

Exercise interventions designed for improving balance are typically those in which participants exercise in standing and moving positions of increasing difficulty so as to challenge the body's ability to anticipate and respond to the demands of different tasks or environments (Winter 1995). For balance to improve, participants have to exercise their muscles (and neuromuscular responses) against an external force, as a consequence of voluntary movement, or in response to an unexpected perturbation/stimulus, in order to maintain the body's centre of mass within manageable limits of the base of support or in transit to a new base of support (Rose 2005). After considering this fact total six exercises were chosen for the geriatric group. So this will not only challenge their centre of gravity but also stimulate lower limb muscles to complete the task.

Six exercises are taught to the person and after that each individual is asked to perform the same exercise to confirm that they have understood properly. Five exercises is as follows

1. Heel to toe walking-2 minutes
2. One leg standing-up to maximum time or maximum 1 minute
3. Foreword lunges-10 repetition with 5 sec hold
4. Step up-10 repetition on both side with usual step height that is 12 to 14 inches
5. Mini squat ( holding with chair /table )-10 repetition
6. Standing with arm and heel raise -10 repetition with 5 sec hold

*Each individual is asked to perform these exercise five times in a week for six weeks. After each week reminder was given to the participants regarding the continuation of the exercise programme by telephone. And after six weeks again BBS score was measured and compared with the previous score.*

### **3: OUTCOME:**

*Primary outcome was BBS. The score of BBS was taken before and after 6 weeks of training of physical exercise.*

### **4: STATISTICAL ANALYSIS:**

We have included those only who could complete the study for 6 weeks and remaining participants were excluded from the study.

We used paired t test to compare the data between before and after the exercise.

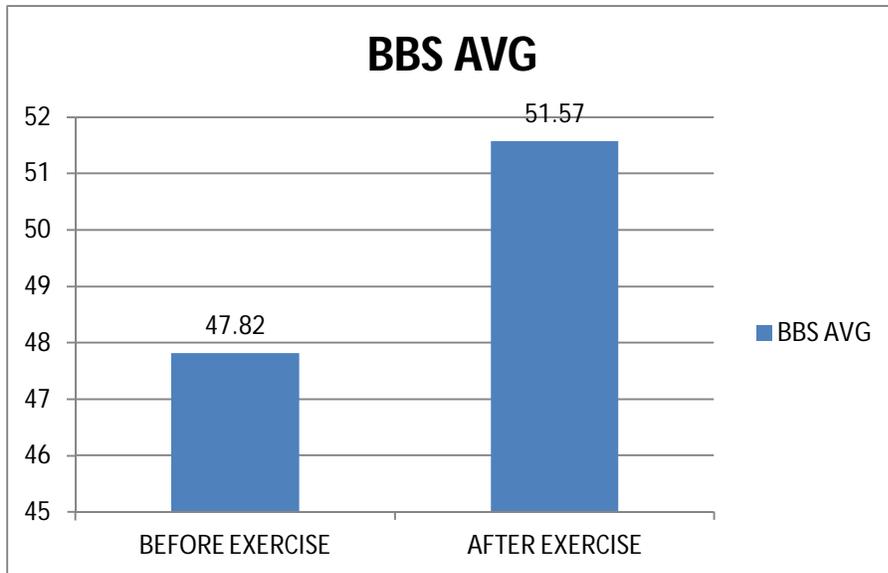
All analysis was done on the simple excel format. Mean, SD and whether the score is significant or not was found out by simple excel formula.

### **5: RESULTS:**

We have included 47 participants in the study but 7 participants could not complete the study so we have excluded them from the study and the end of study the primary data was 40 participants. In the following chart the average score of BBS is mentioned before and after 6 weeks of training, same score is also shown in the chart also.

	BEFORE	AFTER
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	EXERCISE	EXERCISE
BBS AVG	47.82	51.57



The results showed that there is significant improvement in the score of BBS when it compared before and after the exercise. There was improvement in the BBS score in each participant.

## 6: DISCUSSION:

In our study exercise like forward lunges, one leg standing, step up and mini squat exercises includes strengthening of the quadriceps muscle and this can be the primary factor for the improvement in the score of BBS. Other exercise like standing on

heel with arms flexed completely has stimulated calf muscle to work against gravity to complete the task. Calf muscle is anti gravity muscle and walking with the one foot just ahead and the heel of one foot is touched to the fingers of the other foot.

According to Alberta Vallejo et. al., strengthening exercise is an effective means to increase skeletal muscle strength in older persons even in to advanced age. Such improvements translated to enhanced skeletal muscle power which has been correlated with improved gait acceleration , stair climbing speed, improved get up and go times, and other functional measures (stair decent time, berg balance test) in older persons.<sup>27</sup> Binder et.al (2005) studied the effects of resistive training on 91 in community subjects with frailty syndrome (75 years and older) in a randomized controlled trial and concluded that in general significant ameliorations (up to >50% strength gain) can be expected even after 6 weeks of resistance training at a rhythm of 2-3 sessions per week.<sup>13</sup> This also supports our study.

Muscle weakness particularly of the lower limbs, is associated with reduced walking speed, increased risk of disability and falls in older people.<sup>16</sup> So strengthening of these muscle can improve balance.

## **7: LIMITATION OF THE STUDY:**

This study has included only 40 participants. We have included the participants whose score is more than 50, as BBS suggest that risk of fall is increased as the score is less than 36. So it cannot be concluded that same results would have come if participants score is less than 36.

## **8: CONCLUSION:**

In the old age group muscle weakness, joint stiffness, proprioceptive deficit is very common which leads to imbalance and ultimately increasing the risk for fall. Fall itself is very hazardous for the old age group as bone density will be reduced and can cause fracture of upper limb or lower limb bone. So it is highly advised that weight bearing exercise like one leg standing, tandem walking as well as functional strengthening exercises like forward lunges, mini squatting and stepping exercises can be very helpful for the older individual which increases the balance and strength in the lower limb and reduces the chances of fall.

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