

# Effect of Multicomponent Lower Extremity Training (MLT) Technique on Fall Risk and Functional Mobility in Elderly Population

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## ABSTRACT

**Background:** Ageing is strongly linked to sensory, motor, cognitive impairments that can lead to decreased daily life functioning such as gait disturbances, falls, injuries, and mobility restriction. Reduction in Lower limb muscle strength, Flexibility and balance has been related with aging. Multicomponent Lower Extremity Training (MLT) Technique is a specialized lower extremity training which is designed to improve balance, flexibility and strength of lower limbs. This training includes flexibility, strengthening and balance exercises which is having lower load on spine.

**Purpose:** To evaluate effect of Multicomponent Lower Extremity Training (MLT) Technique on Fall risk and Functional Mobility in elderly population.

**Methodology:** 33 participants were selected according to screening criteria and allocated in one group. The protocol will be given for 1 hour 6 sessions per week for 4 weeks. The outcome measures will be done with fall efficacy scale (FES) and 10 meter walk test.

**Result:** Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre and post treatment values with p-value less than the 5% significance level (i.e.  $0.001 < 0.05$ ) in the study in clinical outcomes post intervention.

**Conclusion:** According to the results of our study, Multicomponent Lower Extremity Training (MLT) Technique proved to be beneficial for fall prevention and improving functional mobility in elderly population.

**Keywords:** Elderly population, Fall risk, Functional mobility, Multicomponent Lower Extremity Training (MLT) technique

## INTRODUCTION

Aging can be defined as the progressive deterioration of physiological functions required for survival and fertility over time<sup>(1)</sup>. Maintaining a high degree of capability into old age is essential for healthy ageing. Daily independence, a higher quality of life, and healthier ageing all demand a high degree of physical activity, functional mobility, and cognition<sup>(2)</sup>. Sensory, motor, and cognitive impairments associated with ageing can lead to impaired daily life functioning, such as gait problems, falls, injuries, and mobility

restrictions<sup>(3)</sup>. Mobility decrease generally precedes the onset of disability in ADLs in the aged population. Mobility issues, which have been demonstrated to be the most powerful predictor of self-perceived handicap, significantly limit participation<sup>(4)</sup>. True ageing changes include lens thickening, collagen cross-linking, increased tissue fragility, loss of flexibility, loss of muscle and nerve cells, diminished ability to withstand stress, and skin wrinkles<sup>(5)</sup>.

Aging has an impact on multiple physiological systems, including the cardiovascular, lymphatic, musculoskeletal,

endocrine, genital, and nervous systems. The maximal heart rate and maximal oxygen consumption during exercise decline with age in the cardiovascular system. The musculoskeletal system's most prevalent issue is arthritis. Muscles' ability to do sustained work is limited by decreased oxygen transport and use. Improving physical functioning or functional fitness components singly or in combination assists older persons to maintain a functional range of motion.<sup>(5)</sup>

The term "fall" refers to an incident that unintentionally brings someone to rest on the ground and is typically brought on by a confluence of inherent and extrinsic risk factors. People over the age of 65 experience falls between 28% and 35% of the time, and this proportion rises with age and frailty level, according to the World Health Organization's (WHO) global study on falls prevention. According to reports, falls among those over 65 are more common in India and can occur at rates between 14% and 53%<sup>(1)</sup>. Falls and their effects are a serious public health concern since they are the second greatest cause of unintentional injury morbidity, accounting for 11% of unintentional injury death rates globally. In 2004, India accounted for one-fifth of the reported 424,000 fall-related deaths. A fall can cause nontraumatic or traumatic injuries ranging from no injuries, bruises, and lacerations to dislocations, fractures, and head traumas, as well as death<sup>(1)</sup>. Age-related increases in fall risk and associated injuries can be attributed to a number of factors, including skeletal muscle system deterioration (sarcopenia and decreased quadriceps muscle strength), sensorial factors (such as vision), and environmental factors (such as fall hazards in the home and the environment)<sup>(6)</sup>.

One of the most common psychological effects of falls is fear of falling (FOF), which is defined as "a persistent worry about falling that may cause an individual to avoid activities that he/she is still capable of performing". FOF is highly prevalent in older people and has a variety of detrimental

effects.<sup>(7)</sup> Greater Fear of Falling in older adults can lead to a crippling spiral of diminished self-esteem, reduced physical activity, and increased mobility restrictions, with numerous and severe side effects including osteoporosis and constipation, increased physical frailty, increased falls, loss of independence, and reduced social engagement. The effects of FOF could be just as serious of a health issue as actual falls.<sup>(7)</sup> Fear of Falling can disrupt attentional processes and jeopardize the acquisition and retention of sensory information required for safe stepping motions during complex locomotor activities<sup>(8)</sup> FOF is linked to visual behaviors that are known to jeopardize walking safety in OA by raising the likelihood of making an incorrect step and tripping.<sup>(8)</sup>

A primary cause of injuries, morbidity, and mortality, fear of falling has been found as an independent risk factor for lower quality of life, activity restriction, independence loss, and fall-risk. Additionally, estimates of the frequency of falls in community-dwelling older persons with FOF range from 29% to 77%.<sup>(8)</sup> Falls are a typical occurrence in older persons, but they can be avoided by focusing on risk factors that can be changed, such as vestibular disorders, postural hypotension, vision impairment, foot issues, and drug side effects. Participating in physical therapy or an exercise program, controlling postural hypotension, referring patients to podiatrists or vision experts, and reviewing and managing medications are all examples of effective evidence-based therapies.<sup>(9)</sup> Older persons with cognitive impairment (CI) are more likely to fall and fracture, with around 60% falling each year. Impaired cognition may raise the risk of falling by impairing a person's ability to make decisions, solve issues, and do tasks concurrently. Furthermore, reduced processing speed and reaction time, as well as gait and balance impairment, have been repeatedly linked to CI and are known risk factors for falls. Previous research has revealed risk factors

for falls such as psychotropic drug use, autonomic dysfunction, depression, symptomatic orthostatic hypotension, and periventricular white matter hypertrophy. Impaired mobility is one of the key reasons of decreased functional capacity.<sup>(10)</sup>

Functional mobility is described as the ability of people to move around in their environment in order to participate in daily activities and move from place to place. Standing, bending, walking, and climbing are examples of movements<sup>(11)</sup>. Impaired mobility is frequent in the elderly and has been linked to an increased risk of falling within the next year, further loss of functional capacity, and subsequent institutionalization. These findings imply that older persons who already have mobility issues are more likely to suffer the negative impacts of aging, and hence it is reasonable to consider this demographic to be the primary target for functional capacity improvement.<sup>(12)</sup>

Multicomponent Lower Extremity Training (MLT) is a specialized technique designed for lower limb flexibility, strength and balance. This specialized technique facilitates muscle activation by stretching the surrounding muscles. This training technique includes 3 exercise steps. It progresses from non-weight bearing exercises to weight bearing exercises which has lower load on spine. In second exercise step several exercises were added that extended spine to greater extent than stage 1 or which could be performed in full standing position without both hands on backrest of the chair. In third exercise step exercises which out additional weight on foot or required maintenance of balance in sitting or standing position were added.

### FALL EFFICACY SCALE

The Falls Efficacy Scale International (FES-I), created and validated by the Prevention of Falls, has become a widely used instrument for assessing concern about falling. The FES is a self-report questionnaire, providing information on level of concern about falls for a range of

activities of daily living. The original questionnaire contains 16 items scored on a four-point scale (1 = not at all concerned to 4 = very concerned). The shortened questionnaire contains seven items.

### 10 METER WALK TEST

The 10MWT is an evaluative measure of walking speed which requires a 20-m, indoor, flat straight hallway. The first and last 5 m are used to accelerate and decelerate while only the middle 10 m are recorded. The patient is instructed to walk at a self-selected speed, using whatever walking aids might be needed, such as a walker or cane. The velocity

### LITERATURE REVIEW

#### 1. Soonhee Kang, PT, PhD et.al. (2015)

The purpose of this study was to determine the effect of Multicomponent exercise for physical fitness in community-dwelling elderly women. Twenty-two healthy community-dwelling elderly women were randomly allocated to either an experimental or a control group. The intervention was given for 4 weeks 3 times per week for 60 mins. In this study multicomponent training program that consists of balance, strengthening, and stretching exercises is a relevant intervention for the improvement of the level of physical fitness of community-dwelling elderly women.

#### 2. Hungu Jung et. al. (2020)

The purpose of this study is to review the effectiveness of Multicomponent Lower extremity training technique on Physical Function in Healthy older adults. Outcome measures used are Functional reach test , TUG test and five times sit to stand.38 participants were randomly divided into 2 groups and intervention was given for 24 weeks once in a week for 60 mins. The findings of this study show MLT improves ROM, Muscle strength and physical performance in healthy older adults.

### 3. N Fusun Toraman et .al (2004)

The purpose of this study was to evaluate the effects of 9 week supervised multicomponent exercise program on functional fitness in older adults. 42 older adults were randomly assigned to exercise group and evaluated before and after intervention. The training program consist of 3 session of walking, strengthening and flexibility exercises. The findings of this study indicate that 9 weeks of multicomponent exercise program increases upper and lower body strength, aerobic endurance and agility in older adults. There was no effect of Multicomponent training on body composition.

### 4. Pothiraj Pitchai et al (2019)

The purpose of this study was to find out a study on prevalence, risk factors, circumstances for falls and level of functional independence among geriatric population. In this study 2049 older adults age 60 years and above were recruited by cluster sampling technique within cities of Maharashtra. Data were collected using FES international, Barthel index and Kuppuswamy and responses were analysed using SPSS software. This study reveals fall as a significant health problem and provides into the influencing risk factors for falls among older adults.

### 5. Denise M.Peters et al(2013)

The primary purpose of this study was to examine the reliability and concurrent validity of Shorter walk test compared with 10MWT for measurements of Gait speed in Healthy, older adults. : Forty-three healthy, older adults performed 3 consecutive walking trials on the 4- and 10-Meter Walk

Tests at their self-selected walking speed. Gait speed measurements for both tests were shown to have excellent test-retest reliability (ICC values of 0.96- 0.98), with similar results for stopwatch and automatic timer assessments. The results shows that reliability of both walking tests is excellent, the 4- Meter Walk Test does not exhibit a high enough degree of concurrent validity with the 10-Meter Walk Test to be used interchangeably for gait speed assessments in healthy, older adults. We therefore recommend using the 10-Meter Walk Test to obtain the most valid clinical assessment of walking speed when using it as a 1-time indicator of health status.

### 6. KIM DELBAERE et al(2010)

The study aimed to perform a comprehensive validation of the 16-item and 7-item Falls Efficacy Scale International (FES-I) by investigating the overall structure and measurement properties, convergent and predictive validity. Five hundred community-dwelling older people (70–90 years) were assessed on the FES-I in conjunction with demographic, physiological and neuropsychological measures at baseline and at 12 months. This study suggests that both scales have acceptable structures, good validity and reliability and can be recommended for research and clinical purposes.

## MATERIALS & METHODS

- Mat
- Armless chair
- Outcome measure
- Stopwatch
- Pen



Fig no 1 Mat



Fig.2 Armless Chair



Fig.3 Pen



Fig.4 Stopwatch

- **Study Type** -An Interventional Study.
- **Sampling Design** – Convenient Sampling.
- **Sample size** - 33
- **Study Population**- Healthy older Adults.
- **Study duration** -6 months
- **Study Setting** – Old age Homes of Sangli District

### STATISTICAL ANALYSIS

Data Analysis was performed using statistical package for Social Sciences (SPSS)software. Statistical analysis done using sample paired t-test.

Within group comparison of pre test and post test scores of Fall Efficacy scale and 10 MWT by paired sample t-test.

Between group independent test for group statistics by using paired sample test

### RESULT

#### Normality test using Shapiro-Wilk

| Variable             | Time frame | z-value | p-value |
|----------------------|------------|---------|---------|
| Falls Efficacy Scale | Pre        | 0.945   | 0.094   |
|                      | Post       | 0.938   | 0.060   |
| 10MWT(m/s)           | Pre        | 0.974   | 0.610   |
|                      | Post       | 0.975   | 0.630   |

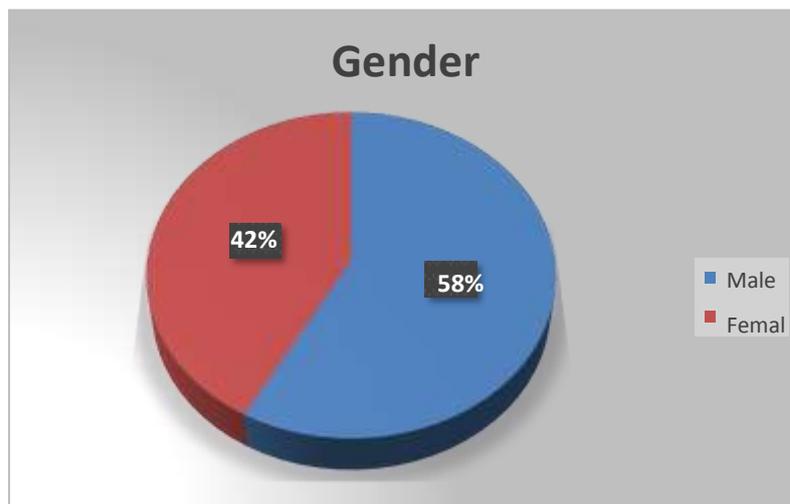
Table.no.1 Shows z-value and P-value of outcome measures

Data set is normally distributed as all the variables have indicated non-significant outcome in the observation.

The researcher shall use parametric test for data analysis purpose in the following sections.

| Percent | Gender | Frequency |
|---------|--------|-----------|
| 58      | Male   | 19        |
| 42      | Female | 14        |
| 100     | Total  | 33        |

Table.no.2- shows percentage distribution of male and females

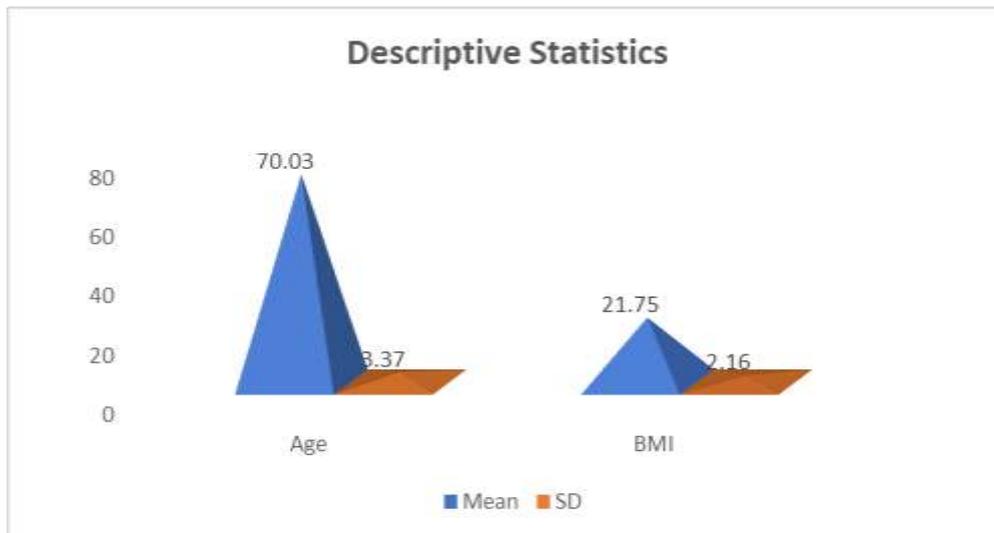


Graph No1: Shows Percentage of male and female distribution

### Descriptive Statistics

| Variables | Minimum | Maximum | Mean  | SD   |
|-----------|---------|---------|-------|------|
| Age       | 65      | 77      | 70.03 | 3.37 |
| BMI       | 18      | 25      | 21.75 | 2.16 |

Table.no.3 shows descriptive Statistics



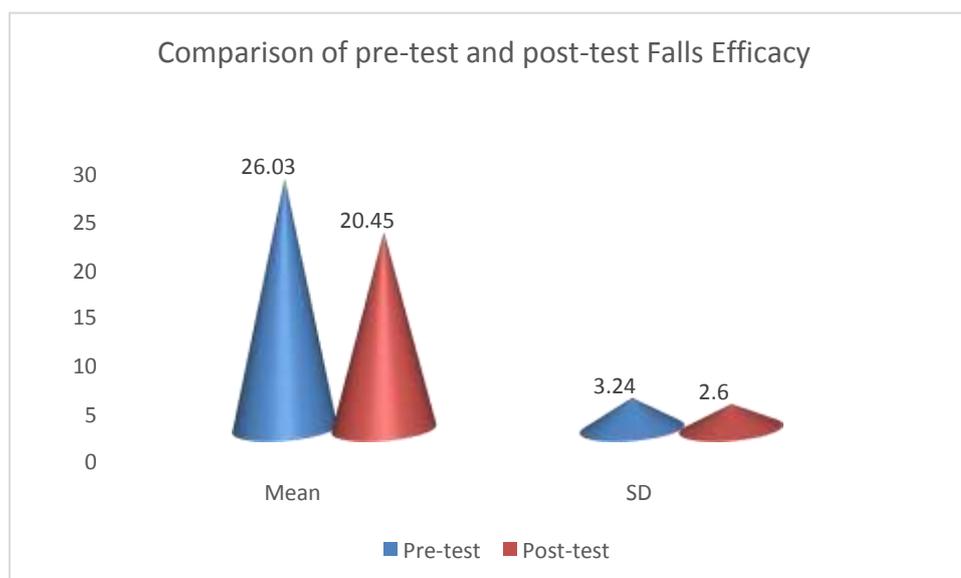
Graph No 2: Shows Mean and Standard deviation of Baseline Data(Age,BMI)

| Time      | Mean  | SD   | Mean Diff. | SD Diff. | Effect size | t-value | p-value |
|-----------|-------|------|------------|----------|-------------|---------|---------|
| Pre-test  | 26.03 | 3.24 | 5.58       | 1.68     | 3.32        | 19.093  | 0.001*  |
| Post-test | 20.45 | 2.6  |            |          |             |         |         |

Table.no.4 shows mean sd and p value of FES Pre and post test

The Falls Efficacy Scale mean value indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less than pre value. The effect size or Cohen's D indicates 3.32 value which is assumed to be very high in effect size as per the standard parameters

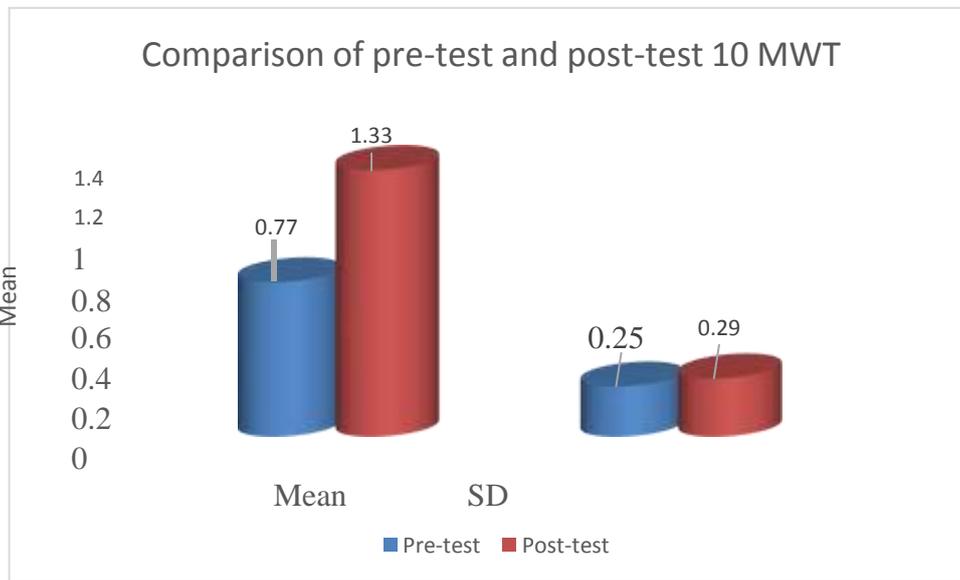
of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention



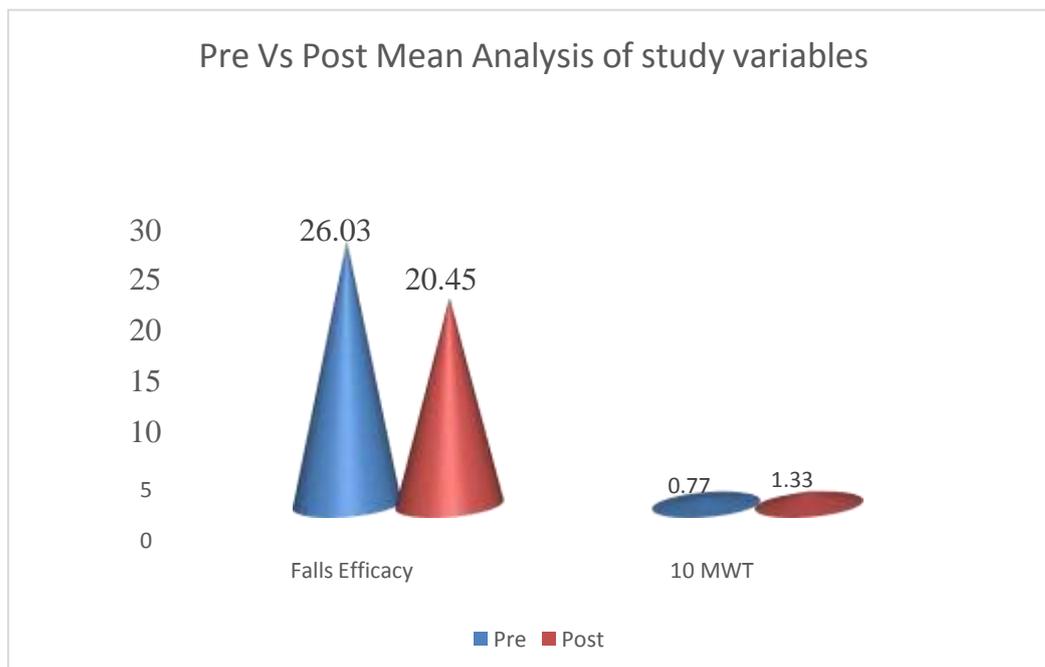
Graph No 3: Shows mean value and standard deviation and difference of pre and post test Values of FES Scale.

| Times     | Mean | SD   | Mean Diff. | SD Diff. | Effect size | t-value | p-value |
|-----------|------|------|------------|----------|-------------|---------|---------|
| Pre-test  | 0.77 | 0.25 |            |          |             |         |         |
| Post-test | 1.33 | 0.29 | 0.56       | 0.15     | 3.77        | 21.647  | 0.001*  |

Table.no.5 shows mean sd and p value of 10MWT Pre and post test



Graph No 4: Shows mean value and standard deviation and difference of pre and post test Values of 10MWT.



Graph No5: Shows comparison of Mean difference between pre and post test values of FES and 10MWT

The 10 MWT mean value indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more than pre value. The effect size or Cohen's D indicates 3.77 value which is assumed to be very high in

effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.001)

< 0.05) in the study and therefore it justifies the improvements in health outcome post intervention

## DISCUSSION

The purpose of this study was to evaluate effectiveness of Multicomponent lower extremity Training (MLT) technique on fall risk and functional mobility in elderly population.

In this study 33 Subjects were participated. Subjects were selected according to inclusion criteria and allocated into one group. Group consist of 19 male and 14 female subjects. Mean age is 70.03 and Mean BMI was 21.75. Pre intervention measurements Fall efficacy scale and 10 meter walk test score were taken.

Subjects were treated with Multicomponent Lower Extremity Training (MLT) technique. In the results a marked improvement in Fall efficacy scale and 10 meter walk test is seen after the treatment of 24<sup>th</sup> session.

Hungu Jung et al (2020) studied Effect of Multicomponent Lower extremity training technique in healthy older adults concluded that significant improvement in ROM of lower limb and improved muscle strength and physical performance in healthy older adults and awareness of age related reductions in lower extremity functions are very necessary to prevent complication among them. A study was done on Multicomponent exercise for Physical fitness of community-dwelling elderly women by Soonhee Kang et al (2014) concluded that Physical fitness of community dwelling elderly women decreases by age. They found significant correlation between level of functional ability and physical fitness. Decrease in physical fitness is significantly related with higher risk of falls and injury. This study suggests that to maintain adequate level of physical function, the elderly need to participate in appropriate physical fitness activities .The First objective of study was to study the effect of Multicomponent Lower Extremity Training (MLT) technique on Fall risk in elderly population . In this

study statistically significant improvement in risk of fall was seen after post intervention assessment. The possible mechanism is Multicomponent Lower Extremity Training(MLT) technique includes balance, flexibility and strength exercises that provides an appropriately intense stimulus while facilitating muscle activation by stretching agonist muscle and its surrounding muscles which results in reducing risk of falls. Maria Justine et al (2011) stated that strength training improves muscle strength ,muscle function and balance and it is necessary to focus on targeted muscle group to improve muscle strength and flexibility Thus, Multicomponent Lower Extremity Training (MLT) technique improves flexibility that leads to improvement in lower extremity strength and thus it improves risk of falls.

The second objective of study was to study the effect of Multicomponent Lower Extremity Training(MLT) on functional mobility in elderly population. Natalia B Moreira et al conducted a study on Perceptive-cognitive and Physical Function in pre-frail older adults vs traditional multicomponent training. The purpose of this study was to compare exergaming vs traditional multicomponent training.

Multicomponent training includes warm up, strengthening exercise, balance and cardiorespiratory exercises followed by cooling down and exergame training includes squats, lunges and tai chi. This study suggests that Multicomponent training shows significant improvement.

Physical function is more sensitive to changes in power production capacity than muscle strength. Training stimuli with lower loads and faster movement speeds are better suited for lowering the activation threshold of fast-twitch motor units and increasing their initial firing rates, resulting in expressive power production and torque development. This training has improved ability to generate a faster torque initiation may aid in improving functionality and preventing falls.

The results of present study shows that significant difference is seen between pre and post test scores. So that, Multicomponent Lower Extremity Training (MLT) technique is statistically effective in improving fall risk and functional mobility in elderly population.

## CONCLUSION

This study concluded that Multicomponent Lower Extremity Training (MLT) technique shows significant improvement in Fall risk and Functional mobility in elderly population

## Declaration by Authors

**Ethical Approval:** Approved

**Acknowledgement:** None

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

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