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TO STUDY THE EFFECT OF LOW IMPACT AEROBIC EXERCISES ON PHYSICAL FUNCTION OF LOWER EXTREMITY IN SEDENTARY ELDERLY PEOPLE

Ronnica Borge[1*], Dr Vijaya Bagade (PT)[2], Dr Albin Jerome (PT)[3]
[1*] Intern, St. Andrews College of Physiotherapy, Manjari Phata, Indraprastha Society, Hadapsar, Pune, Maharashtra
[2]Professor, St. Andrews College of Physiotherapy, Manjari Phata, Indraprastha Society, Hadapsar, Pune, Maharashtra
[3]Principal St. Andrews College of Physiotherapy, Manjari Phata, Indraprastha Society, Hadapsar, Pune, Maharashtra

***Corresponding Author:** ronnica77@gmail.com
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ABSTRACT

Background: Aging often leads to decline in physical function especially in the lower extremity which predisposes the elderly to a sedentary lifestyle contributing to poor health outcomes and difficulty in performing daily tasks.

Objective: This study aimed to evaluate the effect of low impact aerobic exercises to improve the physical function of lower extremity in sedentary elderly in Pune specifically targeting balance, gait speed and ability to perform chair sit to stand.

Methods: A six-month quasi-experimental study was conducted among twenty-seven sedentary adults aged 65-74 years in Pune. Participants included individuals who could walk without assistive devices and excluded individuals who were active (⩽1.5 MET), who had a recent fracture or lower-limb injury, major medical or psychological conditions. They were assessed using Short Physical Performance Battery before and after a low impact aerobic exercise program, performed 40-45 minutes daily, five days per week for one month. Data was analysed using paired t test, with $P<0.005$ considered as significant.

Result: The participants demonstrated statistically significant improvement in all domains of the outcome measure: balance ($p<0.0001$), gait speed ($p<0.0001$), chair sit to stand ($p<0.0006$) and total score ($p<0.0001$). This suggests that there were improvements in the functional mobility and lower extremity function.

Conclusion: The findings suggest that a simple, low impact aerobic exercise protocol can effectively improve the lower extremity physical function in sedentary elderly individuals. It can help counteract the sedentary lifestyle while also providing musculoskeletal and cardiovascular benefits, enhancing the ability to perform functional tasks efficiently and independently.

Keywords: Low-impact aerobics, elderly, sedentary, physical function

INTRODUCTION

Sedentary behaviour refers to activities that expend ≤ 1.5 metabolic equivalents while sitting or reclining during waking hours. Among all age groups, older adults are the least physically active, spending an average of 9.4 hours per day in sedentary behaviour. Elevated levels of sedentary behaviour have been

linked to negative health outcomes, including increased overall mortality, heart disease, cancer and higher risk of developing cardiovascular disease, cancer and type 2 diabetes. [1]

Aging affects multiple aspects of gait, leading to reduced functional capacity and changes in the postural system, which in turn influence daily activities. Postural instability is a major concern for older adults and significantly impacts their quality of life. Age-related changes in walking, such as slower step speed and shorter step length, can increase the likelihood of falls, functional decline and potentially the need for hospitalization or long-term care. [2] Reduced quality of life and increased morbidity in older adults has been associated by the age-related decline in cardiorespiratory fitness and physical function.[3]

Participation in strength training, aerobic exercise or a combination of both can help maintain muscle and cardiorespiratory function while preventing further disuse atrophy and deconditioning, particularly in individuals with muscle disorders.[4] Regular exercise, in older adults has multiple benefits, including improved muscle strength and enhanced oxygen utilization by muscles. Additionally, physical activity contributes to reduced risk of coronary heart disease and improves lipid and glucose metabolism. Aerobic exercise has proven to positively influence stroke volume, maximal cardiac output and maximal arteriovenous oxygen difference.[5]

Consistent physical activity has been associated with reduced mortality and decreased age-related morbidity among older adults. Moderate aerobic exercise can improve cardiovascular health and may help prevent cardiovascular diseases in healthy elderly.[5] Exercise also provides mental health benefits by delaying cognitive decline and the onset of dementia, while supporting overall well-being. Impaired balance is common in older adults and contributes to an increased risk of falls. Strength training has shown to cause improvements in balance in elderly population, including those in nursing homes, while aerobic resistance training.[6]

The Short Physical Performance Battery (SPPB) is widely recognized as a tool for evaluating geriatric syndromes. It measures physical performance through assessments of balance. Limb strength and gait. It includes three tests: standing balance in three positions, chair rise to evaluate lower limb strength and power and walking speed at a normal pace.[7]

METHODOLOGY:

The present study adopted a quasi-experimental design and was carried out in Pune over a period of six months. Participants were selected using a convenient sampling method. The sample consisted of 27 sedentary older adults, and the sample size was determined using openepi software.

The participants were men and women between sixty-five and seventy-four years of age who were able to walk without any assistive devices. Individuals who were active (≤1.5 MET), who had a recent fracture or lower-limb injury, major medical or psychological conditions, such as uncontrolled hypertension or diabetes, cardiovascular disease, or a history of stroke, were excluded.

Ethical approval for the study was obtained from the Institutional ethical committee. Participants were recruited based on the inclusion and exclusion criteria, informed about the study and a written consent was taken from them. Baseline data was collected using the Short Physical Performance Battery which assessed their lower extremity function through three components: a standing balance test, a gait speed test, and a chair sit-to-stand test. The total SPPB score was recorded for each participant. The required equipment included a stopwatch, a chair, and a measuring tape.

Following the baseline assessment, participants underwent a low impact aerobic exercise program which also included a warm-up and cool-down period.

WARM UP

- Duration: 10 mins
- Protocol (10 Repetitions)-
  - Neck ROM exercises
  - Shoulder-Elbow-Wrist ROM exercises

- Standing Trunk Rotations
- Hip Knee Ankle Movements
- Ankle Toe Movements
- Dynamic Quads

AEROBIC PROTOCOL

- Duration: 25 mins
- Mode: Circuit Training
- Protocol (10 Repetitions, 2 sets)-
- Heel Raises (Chair support)
- Sit to Stand
- Spot Marching
- Side steps (side walking)
- Mini Squats (wall slides)

COOL DOWN

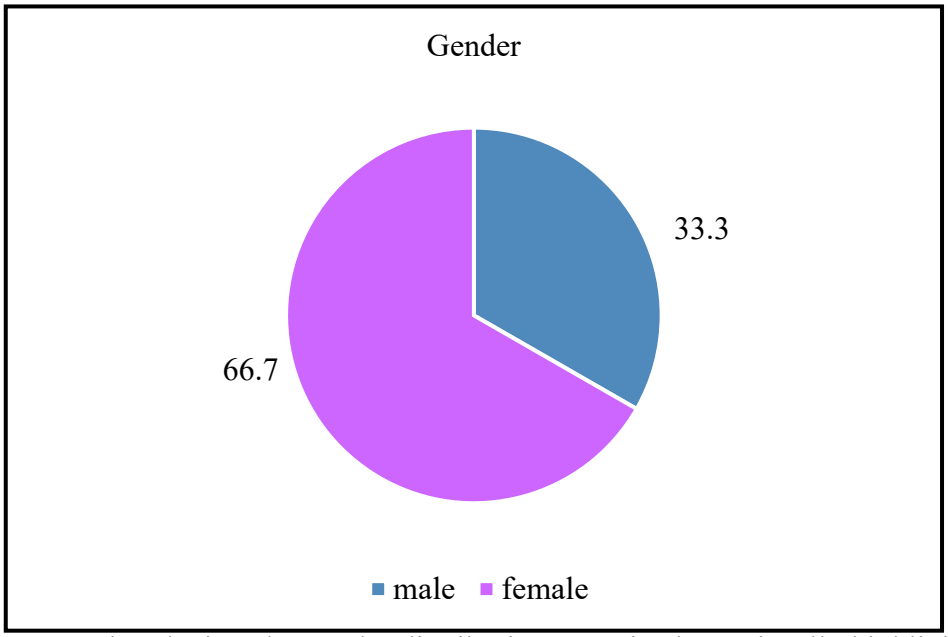
- Duration: 10 mins
- Protocol (5 Repetitions, 15 second hold)-
- Neck Stretches
- Shoulder capsular stretch
- Seated Hamstring Stretch
- Adductor Stretch (Butterfly)
- TA stretch (wall support)
- Breathing Exercises (Diaphragmatic Breathing)

Each session lasted for approximately forty to forty-five minutes and was carried out for a month, five days per week. Post intervention data was collected by re-evaluating their lower extremity function using the Short Physical Performance Battery. Paired *t*-tests were performed to compare pre- and post-intervention scores for balance, gait speed, chair stand, and total physical function.

RESULTS:

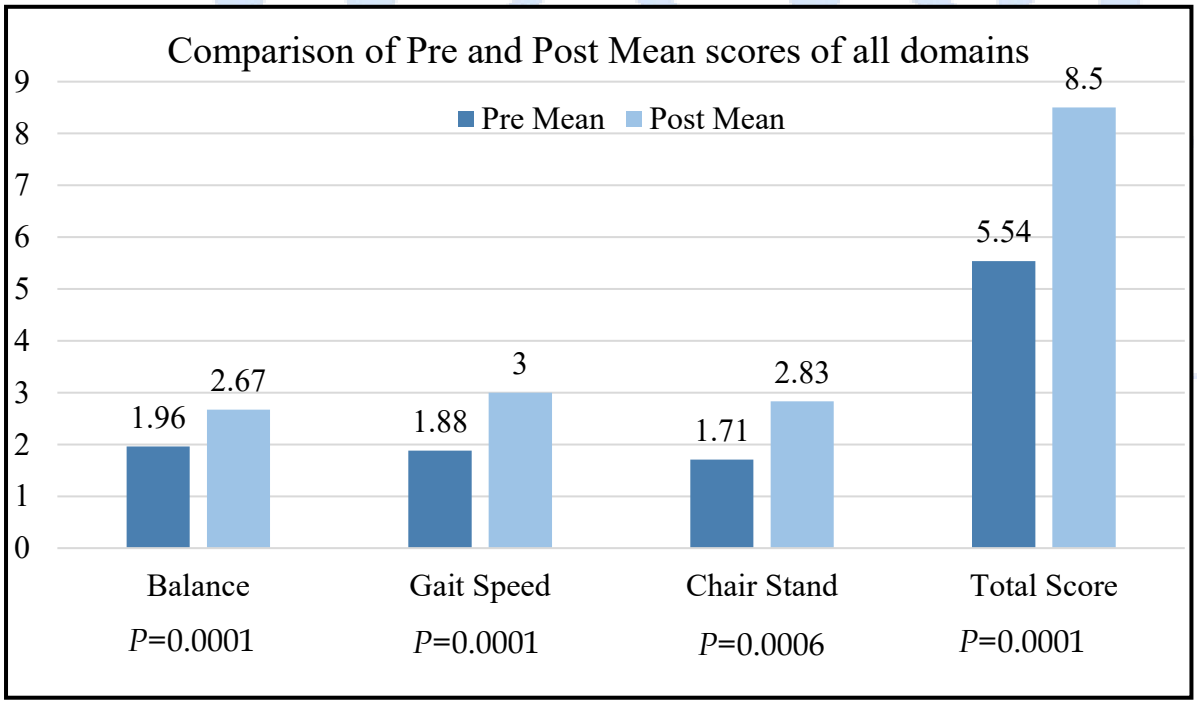
The mean age of the participants was 69.26 ± 2.74 years. Out of twenty-seven, eighteen were female and nine were male. The collected data was analysed using descriptive and inferential statistics. Mean and standard deviation was calculated for continuous variables, while frequencies and percentages were used for categorical variables. A significance level of $p < 0.05$ was considered statistically significant. Paired *t*-tests were applied to compare pre- and post-intervention scores.

Graph 1: Gender Distribution



Interpretation: Graph 1 depicts the gender distribution as a pie chart, visually highlighting the predominance of female participants in the study. The chart clearly shows that two-thirds of the sample were female, with males comprising one-third.

Graph 2 : This chart denotes the Comparison of pre- and post-intervention scores



Interpretation: Graph 2 presents the pre- and post-intervention score across the functional domains as a summary chart with mean and p values. The graph illustrates improvements in balance, gait speed, and chair stand performance, resulting in an overall increase in the total score.

DISCUSSION:

This study assessed the effect of a low-intensity aerobic exercise program on the lower limb functional abilities of inactive older adults. The primary goal was to determine whether a readily accessible protocol that is also feasible for use in the community would be able to enhance the daily functional capacity, leading to overall improved quality of life and minimizing adverse impacts on health associated with sedentary lifestyle in elderly.

According to the World Health Organization (WHO) recommendation, the elderly aged over 65 years should perform moderate intensity physical activity for at least 150 min per week and aerobic activity in bouts of 10 minutes duration. They are also recommended to perform physical activity to enhance balance and prevent falls on 3 or more days per week along with muscle strengthening activities involving major muscle groups on 2 or more days per week. [8]

Exercise has been shown to be one of the most effective ways to improve balance and prevent falls in the older individuals. Exercise programs that specifically challenge balance and are done regularly can significantly reduce fall risk in community-dwelling older adults (Sherrington et al., 2019). [9] Strengthening stabilizing mechanisms helps improve proprioception and reduces sway, contributing to improvement in balance. Targeted balance exercises, such as repetitive heel raise and lower body movements, can improve the strength of ankle plantar flexors, which are important for postural control (Lee et al., 2017). [10]

A study by Eugenia et al. (1994), suggested that a group of elderly who participated in 8 weeks of low-intensity aerobic exercise protocol which consisted of stretching and strengthening chair exercises improved their balance by 22%.[11] Similarly, proprioceptive training, which focuses on body awareness and coordination, has shown positive effects on balance, functional movement, and reducing fall risk in older adults living in care facilities (Espejo-Antúnez et al., 2020).[12] Exercises such included in this protocol cover all these areas required for proprioceptive training. According to Dierick et al. (2022), Another simple but effective exercise for improving balance is side-stepping, which can be personalized and progressed over time. This method helped improve stability and mobility in elderly individuals who were frequent fallers in nursing homes.[13]

According to Kato et al. (2021), exercises like marching in place and chair rises help to increase lower limb power, which supports the push-off and propulsive phase during walking an important factor in improving gait speed.[14] Improvements in gait speed also correlate with better performance in other functional tasks such as getting up from a chair or walking. For example, Kato et al. (2021) noted that participants who improved their walking speed also performed better on tasks like the 10-meter walk and chair rise tests. These functional gains are critical for maintaining independence in daily life.[14]

As people age, they naturally lose muscle mass and strength, particularly in the lower body, which can affect their ability to perform everyday tasks such as standing up from a chair, climbing stairs, or walking. Among lower limb muscles, the knee extensors tend to experience a more pronounced decline with age, which has been linked to increased effort during daily activities and a higher risk of falls (Abe et al., 2011; Landers et al., 2001).[15][16] According to Flanagan et al. (2003), with older adults, Chair Squat places greater demand on the hip extensors, whereas Normal Squat (with a Self-selected depth) places greater demand on the knee extensors and ankle plantar flexors. He suggested that clinicians may use these discriminate findings to more effectively target specific lower-extremity muscle groups when prescribing exercise for older adults.[17]

Limitation

This study did not include a control group, which reduces the ability to compare the intervention outcomes with natural changes or external influences. However, the design and consistent participation of the elderly individuals provide reasonable confidence in interpreting the observed improvements. Thus, integrating basic, progressive strength exercises into daily routines is a safe and effective way to maintain physical function and enhance overall quality of life as people age.

Clinical Implication

The benefits of this protocol showcase its potential to be implemented in clinical and community settings, including community centres, outpatient clinics, and home-based care as they are practical, cost effective and simple. They can also be used as preventive health strategies as it may help to delay the progression of age-related functional decline thereby reducing the socioeconomic burden associated with elderly care.

CONCLUSION:

These improvements suggest that these simple, accessible and joint friendly exercises performed regularly can strengthen lower limb musculature, enhance balance and coordination, and build confidence in

movement. Being aerobic in nature they also support cardiovascular health and healthy aging. They require only basic equipment like a chair and can easily be performed in any setting.

Further Scope

Future research should investigate the long-term effects of the observed improvements through extended intervention periods and follow-up assessments. Randomized controlled trial designs would provide stronger evidence of efficacy.

ETHICAL COMMITTEE APPROVAL TAKEN FROM INSTITUTE

CONFLICT OF INTEREST NIL

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