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Effect of square stepping exercise versus Otago exercise for elderly to prevent fall and injury related to fall – A comparative study

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1. *Abstract :* This study has been undertaken to investigate the effect between square steeping exercise(SSE) and Otago exercise programme (OEP) to prevent fall and injury using fall of efficacy , time up and go(TUG), functional reach. Falls are a main cause of morbidity and disability in the elderly. More than one-third of persons 65 years, of age or older fall each year, and in half of such cases the falls are recurrent. There are few studies done individually on Square steeping exercise and Otago exercise to prevent fall in elderly but no prior study investigated the comparison of square stepping exercise versus Otago exercise to prevent fall prevention in old adult. Sample size of 38 where taken from which Otago exercise group (n=19) and Square steeping exercise group (n=19)were divided randomly. In comparison between these intervention for their effectiveness, it was found that Square steeping exercise is more effective than Otago exercise in reducing risk of fall . Hence, the study rejects null hypothesis. Statistical analysis proves that SSE are significantly effective in reducing risk of fall and improving balance with p-value< 0.001 for functional reach test and p-value<0.002 for TUG.

IndexTerms **– fall prevention , balance , Otago exercise, Square steeping exercise**

I. INTRODUCTION

Falls and poor bone health are major causes of disability and accidental home deaths in the older population. Falls among older adults are a serious public health problem that can cause fatal injuries sometime, also affects psychosocial status and more importantly quality of life [1]. About 80% of disability stemming from unintentional injuries; which excludes traffic accidents in adults aged 50 years and over resulted from falls [1]

The Causes of Falls are Alteration to gait, balance and mobility, or muscle weakness, older person's perception of functional ability and fear relating to falling, Visual impairment, Cognitive impairment and alterations on a neurological examination, Urinary incontinence, Presence of home hazards, Cardiovascular pathology, Medications prescribed

Injuries from fall are Broken Bones, Soft Tissue Injuries, Traumatic Brain Injuries (TBIs), Hip Fractures, Sprained Ankles or Wrists, Cuts and Abrasions, Back and Spinal Cord Injuries, Shoulder Or Neck Injury, Knee injuries.

The majority of falls are not the result of a single cause, but instead due to multiple interactions between an individual with tendency to fall and acute mediating factors.

Individual Characteristics Associated with Falls: -

In older adults, the incidence of falls increases steadily with advancing age. Not only are chronic medical conditions associated with falls, such as cognitive impairment and arthritis, more common in older adults, but physiologic changes of normal aging are also believed to increase the risk of falls. Parkinson's Disease may increase the risk of falls through a number of mechanisms including increased rigidity of the lower musculature, bradykinesia, orthostasis, and in some cases, cognitive impairment.[14] Stroke is another neurological condition that has been consistently associated with falls. Motor weakness in this group was less predictive of falls. Dementia, regardless of aetiology, is a strong predictor of falls, in part due to poor safety awareness. Osteoarthritis is another chronic medical condition associated with an increased risk of falls. [16] Osteoarthritis of the hip or knee may increase falls by impairing one's ability to manoeuvre around objects. Postural stability may also be influenced if there is a tendency to avoid full-weight bearing on the affected limb. As one might expect, the risk of falling increases as the number of co-morbidities increase.

Physiologic changes of normal aging may increase the risk of falls. For example, with normal aging there is diminished input from the visual, proprioceptive, and vestibular systems, which may result in alterations of balance.

Medications may be one of the most common and potentially reversible risk factors for falls in the elderly. Psychotropic medications (benzodiazepines, antidepressants, sedative hypnotics, anticonvulsants, and neuroleptics) have been strongly associated with an increased risk of falls in a number of studies.

Acute Mediating Risk Factors for Falls are Environmental hazards including wet floors, poor lighting, and improper bed height may increase the risk of falls .Additionally, relocation to a new environment may be a risk factor for falls. Acute intrinsic hazards may result in falls as well. For example, sleep disturbances are associated with an increased fall risk independent of sedating medications. Acute illnesses, such as fever and dehydration, can also potentially result in falls mediated through delirium, orthostasis, and medication use .

Fall is a preventable event. One way to prevent falls is through training [8] .Walking is a widely accepted exercise and is used as a means to develop functional fitness in population-based fall prevention programs. However, older adults may experience difficulty in walking in unfavorable weather conditions such as rain, wind, cold, or heat waves. Furthermore, the fear of injury, disease, accident, and crime may prevent them from walking outdoors. [7]

The SSE aims to maintain and improve elderly people's physical and cognitive functions. SSE is an exercise that involves continuous movement in the forward, backward, left/right, and diagonal directions (stepping) [1]Considering that older adults face these situations in daily life, we have attempted to develop a SSE that they can easily perform indoors, composed of movements similar to walking. Walking involves only forward-stepping movements, whereas SSE involves varied movements in multiple directions and is performed on a thin mat (100 3 250 cm) that is partitioned into 40 squares (25 cm each) [7]

The OEP was developed to reduce falls in older persons. The OEP consists of 17 strength and balance exercises and a walking program, performed two times a week by the older adult in the home, outpatient, or community setting. Exercises can be done individually or in a group setting. Studies demonstrate OEP participants experience a 35 – 40% reduction in falls. The program is most effective for frail older adults. [8]

Hence, this study was taken to investigate the effect of square stepping exercise versus Otago exercise

METHEDOLOGY

1.Sample size: 38

SAMPLE SIZE CALCULATION: Sample size for equality of two means

$$n = 2\,\frac{Z_1^2\, s^2}{d^2}$$

where, m1=2.22 s1=0.12 m2=12.05 s2=2.96 s=pooled S.D=2.09 d= absolute precision = 0.8

z_1= 1.28 at α = 5% level of significance z_2 = 1.28 at 90 % power of test

$$n = \frac{2(1.64)^2\,(2.09)^2}{(0.8)^2}$$

n= 38

minimum sample size = 38

n1=19 n2=19

2.Study design: Comparative study

3.Method of sampling: Convenient sampling

4.Place of study: old age home in Jalgaon & Bhusawal

5.Duration of study: 6 months

6.Selection of criteria

A. Inclusion criteria

1) subjects with informed consent
2) both gender
3) subjects of and above 65 years of age

B. Exclusion criteria

Fracture of lower limb

Any ankle trauma

Vestibular impairments

Visual impairments

MATERIAL :-

1)Adhesive tape marker **3)** chalk
2) stopwatch **4)** chair

OUTCOME MEASURE :-

1. Time up and go
2. Fall of efficacy
3. Functional reach

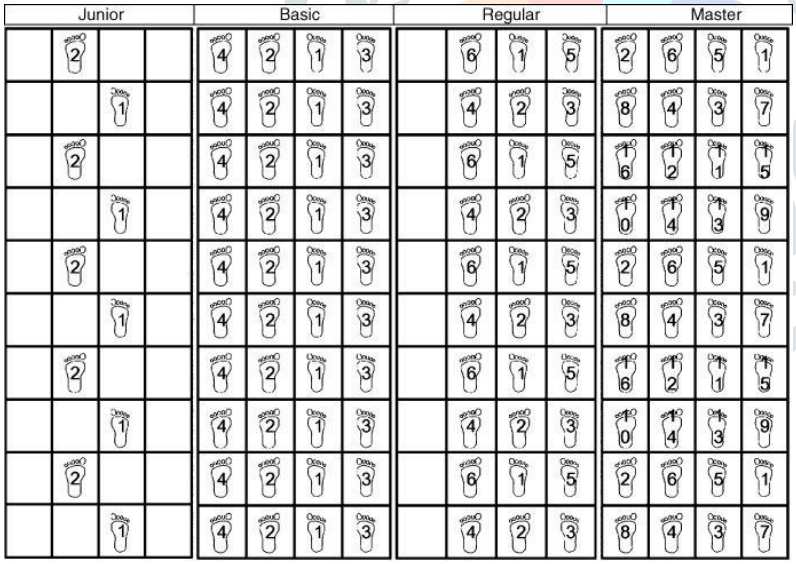
PROCEDURE

To conduct the following study permission was taken from Dr.Ulhas patil college of Physiotherapy , Jalgaon. Ethical clearance was obtained from institutional ethical committee. The purpose & procedure of the study was explained to participant. Subjects was screened according to inclusion and exclusion criteria. A written consent was obtained from subjects.

The selected subjects were divided into 2 groups Group A received square steeping exercise for 40 min, 3 times / week on alternate days for 4 weeks. Group B received Otago exercise for 40 min, 3 times / week on alternate days for 4 weeks. Pre & post intervention outcome was recorded.

Group A (SSE) pre and post assessment fall of efficacy, functional reach, time up and go test was conducted. The SSE group participated in the supervised group sessions thrice a week over the 4-week period. Each session comprised 15 minutes of warm-up activities such as stretching, 40 minutes of SSE, and 15 minutes of cool-down activities. The persons were instructed to walk (step) from one end of the mat to the other according to the step pattern provided When the persons reached the end of the mat, they were instructed to return to their start positions by walking normally off the mat and then stand in line for the next stepping. The SSE included forward, backward, lateral, and oblique step patterns. After the persons became familiar with each of these step patterns, they were instructed to walk with their heels lifted, that is, on their toes, without treading on the frames of the squares.

Each step pattern was repeated 4–10 times to ensure that the persons could complete the pattern, and was followed by the introduction of a more complex step pattern. In total, 196 step patterns were developed and categorized (based on progressively increasing levels of complexity) The persons were encouraged to concentrate in order to successfully perform each progressively more complicated step pattern. They required 15–20 seconds to complete each step pattern initially, they eventually completed each pattern in, 15 seconds.



Group B (OTAGO) Pre and post assessment fall of efficacy, functional reach, time up and go test was conducted
Otago training was conducted with 12 movements:

1)warming-up**:-**Head movements: stand up tall and look ahead , slowly turn your head as far as you can to the right slowly turn your head as far as you can to the right repeat this 5 times ,chin tucks, back extension: stand up tall with feet shoulder width apart place hand on your back gently arch back repeat this 5 times.

2) front knee strengthening

3)back knee strengthening

4) side hip strengthening: stand up tall beside the bench strap the weight on to your ankle hold on the bench keep the exercise leg straight and the foot straight forward lift the leg out to the side and return, repeat this 5 times

(5) calf raises

6) toe raises:-Stand up tall ,Hold on look ahead ,Your feet should be shoulder width apart ,Come back onto your heels, raising your front foot off the floor, Lower your feet onto ground ,Repeat this exercise 5 times .

7)sit to stand: -sit on a chair which is not too low ,place feet behind the knees ,lean forward over knees ,stand up without using your hand ,repeat this 5 times .

8) heel walking: stand up tall and look ahead ,come back onto heels, raising the front of the floor ,walk 10 steps on your heels

9) toe walking :-stand up tall, place hand on wall or table top ,lift heels, stand on toes ,walk 10 steps forward on toe .

10) heel toe standing

11) sideways walking
12) Stair walking
13) cooling-down.

Otago training was conducted thrice a week for 4 weeks.
Each session was conducted for 40 min including warm-up and cooling-down.

STATISTICAL ANALYSIS

The data was collected, analyzed and was entered in excel sheet and statistical analysis was done using SPSS statistical package of social sciences version 28.0.1.1 software. The statistical analysis was done using paired and unpaired t-test. Paired t-test was used for statistical hypothesis to compare pre and post intervention values within groups. The unpaired t-test was used for between groups statistical analysis to compare post intervention values of both the groups. Statistical significance was set at $p \leq 0.05$

RESULTS

The present study included 38 subjects with risk of fall who met the inclusion criteria. The subjects were equally divided into two groups by simple random sampling method. Group A and Group B both consisted 19 subjects.

Group A received square steeping exercise and Group B received Otago exercise for fall prevention.

Table no.1 Statistical analysis in group A (SSE)

Test		Mean	Sd	P value	T value
Fall of efficacy	Pre	50.05	19.54		
	Post	37.53	16.32	<0.001	6.724
Functional reach	Pre	12.00	4.7		
	Post	17.68	5.0	<0.001	-6.812
Time up and go	Pre	21.63	10.42		
	Post	16.42	7.2	<0.001	5.015

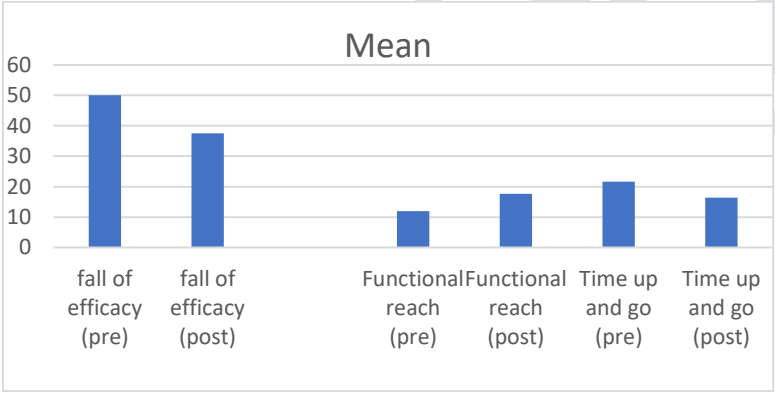


Table 1 shows pre and post intervention reading of square steeping exercise. The mean and SD of pre fall of efficacy are 50.05 ± 19.54 and post mean and SD is 37.53 ± 16.32. The result was statistically significant with $p<0.001$ it shows the improvement after treatment.

The mean and SD of pre functional reach out is 12.00 ± 4.7 and post mean and SD is 17.68 ± 5.0. The result was statistically significant with $p<0.001$ it shows the improvement after treatment

The mean and SD of pre time up n go is 21.63 ± 10.42 and post mean and SD is 16.42 ± 7.2. The result was statistically significant with $p<0.001$ it shows the improvement after treatment.

Table no.2 Statistical difference in group B (Otago)

Test		Mean	Sd	P value	T value
Fall of efficacy	Pre	44.42	15.85		
	post	41.05	17.52	<0.001	4.366
Functional reach	Pre	10.21	2.85		
	Post	11.32	3.78	<0.060	-2.066
Time up and go	Pre	23.63	7.38		
	Post	21.16	7.94	<0.002	3.564

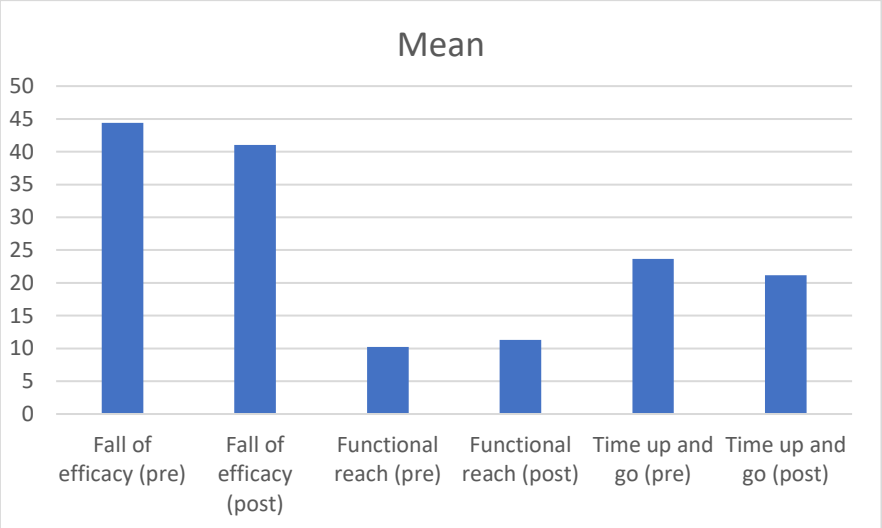


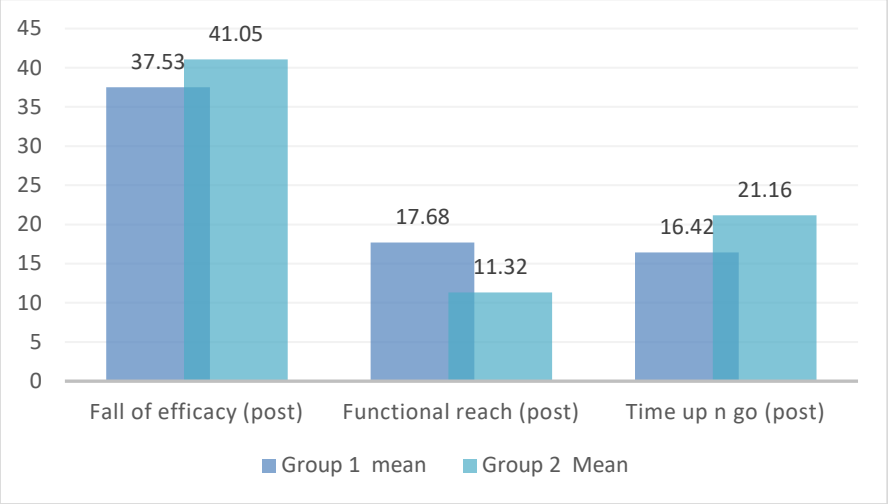
Table 2 shows pre and post intervention reading of Otago. The mean and SD of pre fall of efficacy is 44.42 ± 15.85 and post mean and SD is 41.05 ± 17.52. The result was statistically significant with p<0.001 it shows the improvement after treatment.

The mean and SD of pre functional reach out is 10.21 ± 2.85 and post mean and SD is 11.32 ± 3.78. The result was statistically not with p<0.060 it shows no improvement after treatment

The mean and SD of pre time up n go is 23.63 ± 7.38 and post mean and SD is 21.16 ± 7.94. The result was statistically significant with p<0.002 it shows improvement after treatment

Table 3 (statistical difference between group A and B)

	Group 1		**Group 2**				
Test	**mean**	**Sd**	**Mean**	**Sd**	**P value**	**T value**	**Significance**
Fall of efficacy (post)	37.53	16.32	41.05	17.5	0.525	- 0.642	Not significant
Functional reach (post)	17.68	5.05	11.32	3.78	<0.001	4.39	significant
Time up n go (post)	16.42	7.29	21.16	7.94	0.64	-1.91	Not significant



In table 3 Between group comparison of post intervention value of fall of efficacy mean is 37.53, functional reach mean is 17.68, time up n go mean is 16.42; when it is compared with group B fall of efficacy value with mean of 41.05, functional reach mean is 11.32, time up n go mean is 21.16, the obtained p value is 0.52 which indicate there is statistically no significant difference in values of group A and group B subjects in fall of efficacy.
The obtained p value is <0.001(significant) for functional reach
The obtained p value is 0.64 (not significant) for time up n go.

DISCUSSION

The present study was designed to compare the effectiveness of SSE and Otago in fall prevention. This study provides the evidence of improving in balance, prevent fear of fall and improve perceived health status [1]. Also proves the efficacy of SSE and Otago in reducing risk of fall, maintain and improve physical and cognitive functions. In comparison between these intervention for their effectiveness, it was found that SSE is more effective than Otago exercise in reducing risk of fall in a current study. Hence, the study rejects null hypothesis. Statistical analysis proves that both SSE and Otago exercise are significantly effective in reducing risk of fall and improving balance with p-value< 0.001 for functional reach test and p-value<0.002 for TUG.

It is known that older adults are prone to fall related risks which can make them totally or partly dependent on their family and the community. Significant number of older adults could be permanently disabled or even death can occur as a result of fall down injury. So designing an exercise program is mandatory to prevent fall eventually eliminate fall related injuries and related risks [1] The result shows that risk of fall has been significantly reduced that is p value <0.001. These finding are in accordance with previous study conducted by Berihu Fisseha et al (2017) aim of this review was to determine the effect of square stepping exercise (SSE) for fall down injury among older adults compared with walking training to fall prevention and prevent fear of fall which provide that 4 week of SSE can be used in reducing risk of fall (p value = 0.001) for functional reach [1]

Stefanus Mendes Kiik et al (2020) conducted a study on effectiveness of Otago on health status and risk of fall among elderly with chronic illness which provide 12 weeks of Otago can be used in to reduce the risk of falls and health status among the elderly with chronic illness. Otago exercise significantly improves the health status and reduces the risk of falling among elderly with chronic illness (p value= <0.011) in TUG 8. Similar results were found in Otago exercise group to reduce the risk of falls and fall related injury using TUG whereas, there is no statistical difference found between SSE and Otago exercise group (p value = <0.060).

The physical health usually declines drastically with age, whereas mental health decreases slowly. Therefore, a variety of training programs are attempted in the early elderly age (60–74 years) for various body systems that can still be maintained and improved. Training can improve lower extremity muscle strength, body flexibility, balance, and walking speed. SSE effectively improves balance, functional mobility, lower extremity muscle strength, and functional independence.

One of the training programs that incorporate both cognitive and physical exercise components is the Square Stepping Exercise (SSE). Cognitive and physical exercise done independently can enhance cognition in both cognitively normal and cognitively impaired individuals. By combining both cognitive and physical exercise training in an intervention program may be advantageous to increase this enhancement.

CONCLUSION

The present study concludes that 4 weeks of square steeping exercise and Otago exercise are effective in reducing risk of fall and improving balance. In addition, results supported that among SSE and Otago exercise the SSE is more significantly effective in reducing risk of fall and improving balance using fall of efficacy scale, functional reach scale and time up and go test.

Hence, SSE can be safely used for reducing risk of fall and improving balance.

LIMITATIONS OF THE STUDY

Sample size of the study is small in number.

The assessment was taken prior to the commencement of the exercise protocol and then directly after completion of exercise protocol i.e., 4 weeks. In between no assessment has been taken.

CLINICAL IMPLICATION

SSE is found to be significantly effective in preventing fall related injuries by improving balance. When we see the applicability of SSE to our setup it is easy, cost effective and can be applied in group. Therefore, awareness and practice training shall be conducted for health professionals and the health care community on the effectiveness of physical exercises (SSE) to prevent fall and improve perceived health status among community dwelling older adults.

It can be used as a home-based treatment and can also be implemented among elderly of age group 50 and above years in order to augment their well-being and it will also aid in improving physical fitness and it will help to reduce risk of fall and improve quality of life.

It will also help individuals to participate in various activities during daily life.

FUTURE STUDY SCOPE

Future studies should be done with a larger sample size so as to provide better qualitative analysis.
Study can be done for long weeks.
Future studies should also include with age more than 50 and above years.

REFERENCES

1. Berihu Fisseha1,*, Balamurugan Janakiraman2, Asmare Yitayeh2, Hariharasudhan Ravichandran3,4 Effect of square stepping exercise for older adults to prevent fall and injury related to fall: systematic review and meta-analysis of current evidences 2017 0.12965/jer.1734924.462

2 Ryosuke Shigematsu,1 Tomohiro Okura,2 Masaki Nakagaichi,3 Kiyoji Tanaka,2 Tomoaki Sakai,4 Suguru Kitazumi,1 and Taina Rantanen Square-Stepping Exercise and Fall Risk Factors inOlder Adults: A Single-Blind, Randomized Controlled Trial 2008 10.1093/gerona/63.1.76

3. Stefanus Mendes Kiik Muhammad Saleh Nuwa Effectiveness of Otago Exercise on Health Status and Risk of Fall Among Elderly with Chronic Illness 2020 10.1093/gerona/63.1.76

4. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med. 1988 Dec 29;319(26):1701–1707.

5. Lamb S. Prevention of Falls Network Europe and Outcomes Consensus Group. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe Consensus. JAGS 2005; 53 (9); 161-22.

6. Duncan, PW, Weiner DK, Chadler J, Studenske S. Functional reach: A new clinical measure of balance. J Gerontol. 1990; 45:M192.

7. Tinetti, M., D. Richman, et al. (1990). "Falls efficacy as a measure of fear of falling." Journal of gerontology 45(6): P239org/10.1093/geronj/45.6.P239

8 .Podsiadlo D, Richardson S. The Time “Up & Go”: A Test of Basic Functional Mobility for Frail Elderly Persons. Journal of American. Geriatrics Society 1991 10.1111/j.1532

5415.1991.tb01616.x

9. E Carmeli Functional reach test performance in distance and velocity – A pilot study 2004 10.3109/21679169.2014.911957

10.E Barry · Is the Timed Up and Go test a useful predictor of risk of falls in community dwelling older adults: a systematic review and meta- analysis 2014 10.1186/1471-2318-14-14

11. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. J Aging Phys Act. 1999; 7:129–161.

12. Bassey EJ, Short AH. A new method for measuring power output in a single leg extension: feasibility, reliability and validity. Eur J Appl Physiol. 1990;60:385–390.

13. Shigematsu R, Tanaka K. Age scale for assessing functional fitness in older Japanese ambulatory women. Aging Clin Exper Res. 2000;12:256–263.

14. Nelson ME, Fiatarone MA, Morganti CM, Trice I, Greenberg RA, Evans WJ. Effects of high-intensity strength training on multiple risk factors for osteoporotic fractures. A randomized controlled trial. JAMA. 1994;272:1909–1914.

15. Morozumi K, Yamamoto I, Fujiwara T, et al. Effect of dentures wearing on motor reaction time and balance function in elderly people. J Physiol Anthropol Appl Human Sci. 2004; 23:129–137.

16.Mythili G1, Selvarani E2 and Marcelin Ancy R1. A comparitive study on square stepping exercise versus balance training exercises on fear of fall and balance in parkinsonism patientsDecember 31, 2021 ,10.29328/journal.jnpr.1001042