DOI: 10.7860/JCDR/2021/50115.15488

Original Article

Physiotherapy Section

# Effect of Squat Training with Whole Body Vibration on Balance and Functional Performance in Elderly- A Quasi-experimental Study

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## ABSTRACT

**Introduction:** Elderly population shows many health related disorders which disrupt their functional performance. Exercise training can alter muscle strength, balance, gait, endurance and finally physical function. Whole Body Vibration (WBV) may enhance reduced performance. Hence, the present study evaluated the effects WBV on balance and functional performance in elders.

**Aim:** To assess and compare the effects of squat training on WBV versus plane surface on balance using Timed Get-Up and Go Test (TUG) and functional performance using Short Physical Performance Battery (SPPB).

**Materials and Methods:** This quasi-experimental study was conducted at Dr. D.Y. Patil College of Physiotherapy, Pune, Maharashtra, India from August 2015 to March 2016, including 30 healthy elderly individuals with age between 60 to 70 years. They were divided into group A (Squat training on vibratory surface) and group-B (squat training on plane surface). Training was given for four weeks, three sessions per week. Pretest and post-test values of TUG and SPPB which included balance, gait speed and lower extremity strength was assessed. Epi Info version 7 software was used for statistical analysis.

**Results:** Mean age in group A was 64.53±3.22 years and group B was 65±3.81 years. Group A showed significant reduction (p-value <0.001) in time taken to complete TUG from 15.27 seconds to 12.53 seconds and also group B showed improvement from 14.53 seconds to 13.93 seconds. The SPPB score showed improvement in balance (p-value <0.001), gait speed (p-value <0.001) and strength (p-value <0.001) in group A and gait speed (p-value <0.001) in group B. When compared, Group A showed significant improvement in TUG (p-value=0.01) and lower extremity performance (p-value <0.001) than group B.

**Conclusion:** Squat training on vibratory surface significantly improves balance and functional performance in elderly. Hence, this training can be included as a routine exercise for elderly population with all precautions.


**Keywords:** Aging, Falls, Gait Speed, Strength, Vibratory surface

## INTRODUCTION

Aging is a complex process where changes are observed in molecular, cellular and organ level that results in progressive, predictable and unavoidable changes in body's ability to respond appropriately to external and internal stress [1]. The rate and magnitude of the changes in every system are different from each other but it is an inevitable part of life for everyone [2]. Muscle mass and strength of the muscles reduces by 30 to 50% from the age of 30 to 80 years [3]. Earlier studies have also proved that the fall increases after the age of 60 years to almost by 35-40% as a result of reduced strength, flexibility and balance [4-6]. This affects functional independence and quality of life in elderly.

Falls are a major cause of morbidity and mortality in persons older than 65 years. Falls in elderly is a consequence of impaired balance which is associated with reduced mobility and dependency in activities of daily living among older people. Fall is one of the major significant health issues faced by elderly population and it provides insight into the many contributing risk factors such as age, education, marital status, socio-economic status and circumstances for fall [7]. Fear of fall and restricted activities of daily life are very common amongst older people with or without fall. Many treatment strategies are found useful in treating balance and falls related issues including pilates [8], balance training [9], resistance training [10], dual task training [11], Tai Chi exercises [12], yoga therapy [13] and many more. These interventions are found effective in slowing down the effects of aging on the muscle, but there are elderly people who are unable or unwilling to comply with these exercises.

Whole Body Vibration (WBV) is a new form of training which is performed on a platform that oscillates up and down at a particular frequency and amplitude. It has been promoted as a strength training intervention because it can increase motor unit activity of the lower limbs through reflex induced muscle contraction [14,15].

Squatting exercises place more demand on knee extensors and ankle planter flexors [16], the important muscles for balance and fall reduction [17,18], moreover, it is a functional multi-joint exercise that can be performed at home without any specialised equipment. Hence, the facilitated effects of combining squat training with WBV needs to be investigated further. Hence, present study hypothesised that the effect of squat training on vibratory surface will show better functional performance of lower extremity than exercising on plane surface.

### Study Objective

- To find the effect of squat training on a vibratory surface using WBV on lower extremity function in elderly using Short Physical Performance Battery (SPPB) and Timed Get-Up and Go Test (TUG).
- To assess the effect of squat training on a plain surface on lower extremity function in elderly using SPPB and TUG.
- To compare the effect of squat training on a vibratory surface and squat training on a plain surface on lower extremity function in elderly using SPPB and TUG.

## MATERIALS AND METHODS

This quasi-experimental study was conducted at Dr. D.Y. Patil College of Physiotherapy, Pune, Maharashtra, India from August 2015 to

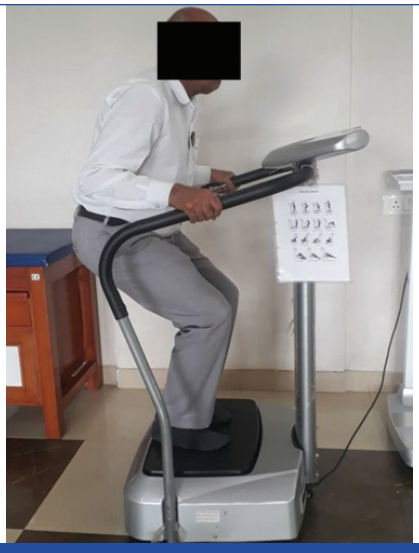
March 2016. Ethical approval was obtained from the Institutional Ethics Committee (DYPCPT/ISEC/02/2015 dated 19/08/2015). Written informed consent was taken from participants after detail information given to all. Healthy elderly individuals are defined as those who can perform their daily activities without any physical discomfort and those who have any morbidity but with medication it is in control (like hypertension, diabetes).

**Inclusion and Exclusion criteria:** Thirty healthy elderly participants with age group between 60 to 70 years and of both genders were taken according to Geriatric Falls Efficacy scoring of 16 to 19 which is a low concern scoring [19]. Participants who had any neurological problems, musculoskeletal diseases or any other chronic illness affecting daily activities and instrumental activities of daily life, any acute inflammatory conditions like tendinitis, synovitis or rheumatoid arthritis, any illness leading to balance deficits, any upper limb or lower limb fracture in last six months which affects squat training, any lower limb prosthesis fitted were excluded.

Total 30 patients were allocated to either a group A or group B of 15 each through purposive random sampling. group A were given squat training on a vibratory surface using WBV and group B was given squat training on a plain surface for four weeks, three sessions per week for both the groups. Pre and post values of outcome measures like TUG and SPPB were documented before four weeks and after the treatment is given for four weeks.

## Protocol

Participants from group A was given squat training with WBVs. Training was given by the same researcher. The frequency used for this study was set at 26 Hz, with peak-to peak amplitude, automatically ranging from 5 to 10 mm. The training volume increased according to the overload principle. Training duration of vibration session was progressed systematically. The subjects were first explained about the protocol and about the WBV machine. The elderly subjects were told about the exercises i.e., squat training to be performed over the vibratory platform and were explained about the benefits of these exercises on the functional performance of lower extremity. They were also explained about the mechanism of vibration on the muscle strength and how this would help in the elderly individuals. The exercises were first demonstrated on a plain surface for the elderly individuals to understand and then demonstrated on a vibratory surface along with proper positioning. The exercise program which included squat training consisted of two exercises as shown in [Table/Fig-1]: Standing With Bent Knees (SWBK) (static squats), which were performed to a maximum depth of 100° of knee flexion, and Dynamic Lower-Limb Exercises (DLLE), which involved dynamic squatting (80% of the total time) and then calf raises (20% of the total time) [20].



**[Table/Fig-1]:** Static squats on vibratory surface.

Warm up of five minutes was given which included ankle toe movements, spot marching, shoulder elevation, wrist movements, trunk rotation heel raises and toe raises etc. Each participant was required to squat to the maximal available depth of knee flexion they could attain on a vibratory platform. The exercise protocol was given in two sets. First week each participant received static squats for 45 seconds then 15 seconds rest and then again 45 seconds of dynamic squats. Two repetitions were given for each exercise. The vibration time increased each week i.e., 45 seconds in the first week, 55 seconds in second week, 65 seconds in third week and 75 seconds in the fourth week. As the program continued, each participant was encouraged to progress deeper squat depth up to 100° of knee flexion. Then a cool down period of five minutes was given which included deep breathing exercises self stretching to TA, hamstrings, quadriceps and obliques. Handles were provided on vibratory platforms if any participants wanted to use them for balance; however, participants were encouraged to perform all the exercises without using help from handles.

The participants in group B were given only squat training without WBV. Similar protocol of group A was given to group B participants expect vibration platform.

Total duration of exercise was 13 minutes 30 seconds in 1st week, 14 minutes 10 seconds in 2nd week, 14 minutes 50 seconds in 3rd week and 15 minutes 30 seconds in 4th week.

### Outcome measures

**1) Timed Up and Go test (TUG):** It also been shown to have validity by virtue of its correlation with measures such as the Berg Balance Scale, gait speed/time, stair climbing, and functional indexes and by its ability to discriminate between patients on the basis of residential status, falls, and mortality. Total time required to complete the task of rise from a standard arm chair, walk to a line on the floor three meters distance and come back and sit on the chair was recorded [21].

**2) Short Physical Performance Battery (SPPB):** It included three more measures: balance, gait speed and lower extremity strength. The SPPB characterises lower extremity function using timed measures of standing balance (side by side stand, tandem and semi-tandem positions), gait speed (timed eight feet walk), and lower extremity strength using repeated chair stand test (timed test of five chair rises) [22].

## STATISTICAL ANALYSIS

Statistical analysis was done using Epi Info version 7 software. The pretest readings of all outcome measures were compared for its non significance so that they are comparable. Level of significance was kept as less than 0.05. After test of Normality, TUG scores were compared using t-test for intergroup analysis and paired t-test used for intragroup analysis. SPPB scores were compared using Mann-Whitney U test for Inter group analysis and Wilcoxon signed-rank test used for intragroup analysis.

## RESULTS

In the present study, the [Table/Fig-2] stated details of demographic data of the participants in the study including mean age, gender distribution in the groups. Geriatric falls efficacy score showed non significant difference in both groups hence they were comparable.

| Particulars | Group A (n=15) | Group B (n=15) |
|---|---|---|
| Age (years) | 64.53±3.22 | 65±3.81 |
| Males | 11 | 6 |
| Females | 4 | 9 |
| Geriatric falls efficacy score | 16.73±1.43 | 17.33±.23 |

**[Table/Fig-2]:** Demographic data analysis.

[Table/Fig-3] was stated pretest values of all the outcome measures TUG and SPPB, and when compared, it showed non significant differences in both groups. This shows both groups were comparable.

| Particulars | Pre score in Group A | Pre score in Group B | p-value |
|---|---|---|---|
| TUG* | 15.27±1.38 | 14.53±1.64 | 0.197 |
| SPPB: Balance** | 2±1 | 2.33±0.81 | 0.417 |
| SPPB: Gait speed** | 2±0.65 | 1.86±0.63 | 0.577 |
| SPPB: Strength** | 2.53±0.74 | 2.33±0.72 | 0.574 |
| SPPB Total score** | 6.53±1.68 | 6.52±1.80 | 0.988 |

**[Table/Fig-3]:** Comparison of Pre-test parameters of outcome measures was done using *t-test and **Mann-Whitney U test. All pretest parameters of outcome measures show not significant difference.
p-value <0.05 were statistically significant; SPPB: Short physical performance battery; TUG: Timed up and go test

[Table/Fig-4] showed intra group comparison in both groups and stated that in Group A, TUG and SPPB (Balance, Gait Speed, Strength and total score) observed significant difference in Pre and Post parameters as p-value <0.001) whereas Group B showed significant difference in pretest and post-test parameters of TUG and SPPB- gait speed whereas SPPB score of balance, strength and total score showed non significant difference.

| Particulars | Pre score | Post score | p-value |
|---|---|---|---|
| **Group A** | | | |
| TUG* | 15.27±1.38 | 12.53±1.24 | <0.001 |
| SPPB: Balance** | 2±1 | 3.4±0.51 | <0.001 |
| SPPB: Gait speed** | 2±0.65 | 3±0.75 | <0.001 |
| SPPB: Strength** | 2.53±0.74 | 3.6±0.63 | <0.001 |
| SPPB Total Score** | 6.53±1.68 | 9.87±1.50 | <0.001 |
| **Group B** | | | |
| TUG* | 14.53±1.64 | 13.93±1.53 | <0.001 |
| SPPB: Balance** | 2.33±0.81 | 2.66±0.81 | 0.055 |
| SPPB: Gait speed** | 1.86±0.63 | 2±0.65 | <0.001 |
| SPPB: Strength** | 2.33±0.72 | 2.53±0.74 | 0.18 |
| SPPB Total score** | 6.52±1.80 | 7.2±1.85 | 0.096 |

**[Table/Fig-4]:** Comparison of pretest and post-test parameters of outcome measures was done using paired *t-test and **Wilcoxon signed-rank test.
p-value <0.05 were statistically significant; SPPB: Short physical performance battery; TUG: Timed up and go test

[Table/Fig-5] indicates comparison of postparameters of outcome measures in group A and B which showed significant improvement in all the outcome measures. Hence, overall result indicated that group A which received squat training on a vibratory surface statistically showed significant improvement than group B.

| Particulars | Group A | Group B | p-value |
|---|---|---|---|
| TUG* | 12.53±1.24 | 13.93±1.53 | p=0.010 |
| SPPB: Balance** | 3.4±0.51 | 2.66±0.81 | p=0.006 |
| SPPB: Gait speed** | 3±0.75 | 2±0.65 | p <0.001 |
| SPPB: Strength** | 3.6±0.63 | 2.53±0.74 | p <0.001 |
| SPPB total score** | 9.86±1.50 | 7.2±1.85 | p <0.001 |

**[Table/Fig-5]:** Comparison of post-test parameters of outcome measures using *t-test and **Mann-Whitney U test.
p-value <0.05 were statistically significant; SPPB: Short physical performance battery; TUG: Timed up and go test

## DISCUSSION

The purpose of this study was to examine the effects of WBV on balance, gait, strength and power changes of lower limbs in older adults aged 60 to 70 years. The mean age of group A was 64.53±3.23 and group B was 65±3.38. The geriatric falls efficacy mean in group A was 16.73 and group B was 17.33.

The intensity and frequency of the exercise program were considered to be reasonable for elderly adults, enabling the exercise to be continued for six months without any fatigue or difficulty. Compliance with exercise is an important factor for preventing falls among elderly, and was 100% in the present study. The WBV along with squat training not only improved the subjects physical functioning, that is body balance, and walking velocity from baseline values, but also it was well tolerated. No serious adverse events, such as fall-related fractures or adverse cardiovascular effects, were observed in the subjects during exercise program, suggesting safety of WBV exercise.

Improvement was observed after four weeks of squat training on a vibratory surface for balance, gait speed and chair stand speed. Strength measures illustrate that WBV increases in lower limb strength, with significantly improvement was observed in balance and TUG. This can be due to larger gains in ankle plantar-flexor strength than in knee or hip flexor or hip extensor strength which is in accordance with previous research demonstrating that vibration predominantly recruits the calf musculature to dampen the stimulus [19]. The WBV can be effective using two training stimuli, the reflex muscle contraction induced by vibration and the body weight exercise performed on the platform. Previous research has reported that strength gains following WBV were associated with the reflex muscle contractions and not the body weight exercises [23].

The present study confirmed that squat training on vibratory surface improves body balance and walking velocity from baseline values. These results suggest a beneficial effect for physical functioning in terms of dynamic body balance and muscle power in elderly adults with locomotive disorders such as knee osteoarthritis and spondylosis. One possible mechanism explaining the effect of WBV exercise on physical function may be that a chain of rapid muscle contractions during exercise might directly activate the neuromuscular system in the lower extremities. Another possibility may be the rapid stimulation of growth hormone secretion after WBV exercise, because it has been shown to elicit an acute growth hormone profile and neuromuscular performance responses immediately after the exercise [24]. A trial in postmenopausal osteoporotic women showed that WBV exercise improved tandem standing time and walking velocity [25], but not TUG and chair rising time compared with non exercising group. Lamont HS et al., showed that six week intervention of squat training using WBV was found to be efficient in getting better squat jump height, 30 cm, depth jump, peak power of 20 kg squat jump when evaluated using isometric test as compared to squat training alone [26-28]. Also, Hazell TJ et al., concluded that when WBV exercises were added to the dynamic squatting, it increases lower limb muscle activity [29]. Current differences in strength which is assessed by SPPB which is more in the group A may be the result of greater WBV induced muscle activity. Improvements in muscular performance following WBV are typically based on neuromuscular enhancement [30]. The potential for chronic neuromuscular enhancement with WBV training would provide a rationale for the increased plantar flexor strength observed in the current study. However, specific neural adaptations were not measured in the current study. The specific contribution of mechanism explaining increased strength following WBV in an older population waits further investigation.

Conversely, Kvorning T et al., reported that combined WBV and resistance training did not additionally increase the maximal isometric voluntary contraction during the leg press [31]. Artero EG et al., reported that addition of WBV exercise to resistance training during an eight week study period did not result in greater improvement of muscular performance compared with an identical exercise program performed without vibration [32].

Regardless of mechanisms, it was clear that WBV contributed to the improved plantar-flexor strength in a group of older adults who were healthy. As the older population exhibits reduced plantar-flexor strength compared with their counterparts [33]. The WBV along with squat training may serve as a therapeutic intervention to combat or counteract reduced plantar-flexor strength and it is beneficial for improving balance, walking velocity (gait speed), and chair rising time (repeated chair stand).

### Limitation(s)

Limitations of the study were small sample size, limited age group, improvements in muscular performance following WBV are typically based on neuromuscular enhancement but specific neural adaptations were not measured in the current study. Turning actions can be taken as further research to evaluate balance more precisely and various Central Nervous System (CNS)/orthopaedic conditions like stroke and old fracture cases.

## CONCLUSION(S)

The present study concluded that squat training on vibratory surface significantly improves balance and functional performance in elderly hence this training can be included as a routine exercises for elderly population with all precautions so that physical function including body balance, muscle power and walking ability in the elderly improves.

### Acknowledgement

Authors would like to thank Dr. D.Y. Patil College of Physiotherapy, Pune, Maharashtra, India, for providing support to conduct the study.

## REFERENCES

[1] Harman D. The free radical theory of aging. Antioxid Redox Signal. 2003;5(5):557-61.
[2] Alexander NB, Schultz AB, Warwick DN. Rising from a chair: Effects of age and functional ability on performance biomechanics. J Gerontol. 1991;46(3):M91-98.
[3] Daley MJ, Spinks WL. Exercise mobility and aging. Sports Med. 2000;29(1):01-12.
[4] Hornbrook MC, Stevens VJ, Wingfield DJ, Hollis JF, Greenlick MR, Ory MG. Preventing falls among community-dwelling older persons: Results from a randomized trial. Gerontologist. 1994;34(1):16-23.
[5] Quail GC. An approach to the assessment of falls in the elderly. Aust Fam Physician. 1994;23(5):873, 876-82.
[6] Hayes WC, Myers ER, Robinovitch SN, Van Den Kroonenberg A, Courtney AC, McMahon TA. Etiology and prevention of age-related hip fractures. Bone. 1996;18(1):77S-86S.
[7] Pitchai P, Dedhia HB, Bhandari N, Krishnan D, D'Souza NR, Bellara JM. Prevalence, risk factors, circumstances for falls and level of functional independence among geriatric population-A descriptive study. Indian J Public Health. 2019;63(1):21-26.
[8] Barker AL, Bird ML, Talevski J. Effect of Pilates exercise for improving balance in older adults: A systematic review with meta-analysis. Arch Phys Med Rehabil. 2015;96(4):715-23.
[9] Gerards MH, McCrum C, Mansfield A, Meijer K. Perturbation-based balance training for falls reduction among older adults: Current evidence and implications for clinical practice. Geriatr Gerontol Int. 2017;17(12):2294-303.
[10] Signorile JF. Targeted resistance training to improve independence and reduce fall risk in older clients. ACSMs Health Fit J. 2016;20(5):29-40.
[11] Silsupadol P, Siu KC, Shumway-Cook A, Woollacott MH. Training of balance under single-and dual-task conditions in older adults with balance impairment. Physical Therapy. 2006;86(2):269-81.
[12] Low S, Ang LW, Goh KS, Chew SK. A systematic review of the effectiveness of Tai Chi on fall reduction among the elderly. Arch Gerontol Geriatr. 2009;48(3):325-31.
[13] Schmid AA, Van Puymbroeck M, Koceja DM. Effect of a 12-week yoga intervention on fear of falling and balance in older adults: A pilot study. Arch Phys Med Rehabil. 2010;91(4):576-83.
[14] Roelants M, Verschueren SM, Delecluse C. Whole body vibration induced increase in leg muscle activity during different squat exercises. J Strength Cond Res. 2006;20(1):124-29.
[15] Dupuis H, Jansen G. Immediate effects of vibration transmitted to the hand. Elsevier, 1981;13:76-86.
[16] Flanagan S, Salem GJ, Wang MY, Sanker SE, Greendale GA. Squatting exercises in older adults: Kinematic and kinetic comparisons. Med Sci Sports Exerc. 2003;35(4):635-43.
[17] Tavakkoli Oskouei S, Malliaras P, Jansons P, Hill K, Soh SE, Jaberzadeh S, et al. Is ankle plantar flexor strength associated with balance and walking speed in healthy people? A systematic review and meta-analysis. Phys Ther. 2021;101(4):pzab018.
[18] Ahmadiahangar A, Javadian Y, Babaei M, Heidari B, Hosseini S, Aminzadeh M. The role of quadriceps muscle strength in the development of falls in the elderly people, a cross-sectional study. Chiropr Man Therap. 2018;26:31
[19] Kim D, Close JCT, Mikolaizak AS, Sachdev PS, Brodaty H, Lord SR. The Falls Efficacy Scale International (FES-I). A comprehensive longitudinal validation study. Age Ageing. 2010;39(2):210-16.
[20] Rees SS, Murphy AJ, Watsford ML. Effects of whole-body vibration exercise on lower-extremity muscle strength and power in an older population: A randomized clinical trial. Physical Therapy. 2008;88(4):462-70.
[21] Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. Physical Therapy. 2000;80(9):896-903.
[22] Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. Journal of Gerontology. 1994;49(2):M85-94.
[23] Verschueren SM, Roelants M, Delecluse C, Swinnen S, Vanderschueren D, Boonen S. Effect of 6-month whole body vibration training on hip density, muscle strength, and postural control in postmenopausal women: A randomized controlled pilot study. J Bone Miner Res. 2004;19(3):352-59.
[24] Torvinen S, Kannu P, Sievänen H, Järvinen TA, Pasanen M, Kontulainen S, et al. Effect of a vibration exposure on muscular performance and body balance. Randomized cross-over study. Clin Physiol Funct Imaging. 2002;22(2):145-52.
[25] Oliveira LC, Oliveira RG, Pires-Oliveira DA. Effects of whole body vibration on bone mineral density in postmenopausal women: A systematic review and meta-analysis. Osteoporos Int. 2016;27(10):2913-33.
[26] Lamont HS, Cramer JT, Bemben DA, Shehab RL, Anderson MA, Bemben MG. Effects of a 6-week periodized squat training program with or without whole-body vibration on jump height and power output following acute vibration exposure. J Strength Cond Res. 2009;23(8):2317-25.
[27] Lamont HS, Cramer JT, Bemben DA, Shehab RL, Anderson MA, Bemben MG. Effects of 6 weeks of periodized squat training with or without whole-body vibration on short-term adaptations in jump performance within recreationally resistance trained men. J Strength Cond Res. 2008;22(6):1882-93.
[28] Lamont HS, Cramer JT, Bemben DA, Shehab RL, Anderson MA, Bemben MG. Effects of adding whole body vibration to squat training on isometric force/time characteristics. J Strength Cond Res. 2010;24(1):171-83.
[29] Hazell TJ, Kenno KA, Jakobi JM. Evaluation of muscle activity for loaded and unloaded dynamic squats during vertical whole-body vibration. J Strength Cond Res. 2010;24(7):1860-65.
[30] Cochrane DJ, Stannard SR. Acute whole body vibration training increases vertical jump and flexibility performance in elite female field hockey players. Br J Sports Med. 2005;39(11):860-65.
[31] Kvorning T, Bagger M, Caserotti P, Madsen K. Effects of vibration and resistance training on neuromuscular and hormonal measures. Eur J Appl Physiol. 2006;96(5):615-25.
[32] Artero EG, Espada-Fuentes JC, Argüelles-Cienfuegos J, Román A, Gómez-López PJ, Gutiérrez A. Effects of whole-body vibration and resistance training on knee extensors muscular performance. Eur J Appl Physiol. 2012;112(4):1371-78.
[33] Simoneau E, Martin A, Van Hoecke J. Muscular performances at the ankle joint in young and elderly men. J Gerontol A Biol Sci Med Sci. 2005;60(4):439-47.

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**PLAGIARISM CHECKING METHODS:** [Jain H et al.]
- Plagiarism X-checker: May 01, 2021
- Manual Googling: Jul 23, 2021
- iThenticate Software: Aug 24, 2021 (18%)

**ETYMOLOGY:** Author Origin

**AUTHOR DECLARATION:**
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Apr 28, 2021**
Date of Peer Review: **Jun 16, 2021**
Date of Acceptance: **Jul 24, 2021**
Date of Publishing: **Oct 01, 2021**