Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Whole Body Vibration (WBV) Therapy Increases Functional Balance Among Individuals

Sergio Sarza Jr., PT, DPT, DRDM[a,b,c]; Aimee Mangoroban, PT, BSc[a,c]; Mary Abigail Go, PT, BSc[a,c*]; Patricia Flores, PT, BSc[a,c]

[a]*College of Rehabilitative Sciences and* [b]*School of Medicine, Southwestern University PHINMA, Cebu City, Philippines;* [c]*Rehabilitation and Wellness Center, Southwestern University Medical Center, Cebu City, Philippines*

Abstract

Physiological changes are evident throughout different stages of life, but physical therapy can offer ways to improve or alleviate these changes. This is a quasi-experimental within group research focused on the effects of whole-body vibration treatment on the balance of both male and female individuals and aimed to prove if their balance improved through whole-body vibration. The respondents received 8 sessions of 15 minutes per session of whole-body vibration. The Functional Reach Test (FRT) and Timed-Up and Go Test (TUG) data were gathered before and after the treatment was recorded and were compared using the paired T-test. Statistically, the mean differences and t-test result show the significant improvement of the recorded data between the pre-test and post-test with alpha level ($p < 0.05$, $t = -8.665$) with mean difference of 0.54 (SD=0.28) and the paired t-test for the Function Reach Test with alpha level ($p < 0.05$, $t = -10.389$) with mean difference of 0. 74 (SD=0.32), while the post-WBV values run against the ages has also shown a positive correlation. Given that, the research proved that whole-body vibration is an effective tool in improving the balance of individuals regardless of their difference in age.

Keywords: Balance, Timed-Up and Go Test, Functional Reach Test, Vibration, Whole- body Vibration

Subject classification codes: include these here if the journal requires them

Introduction

An amount of physiological changes can be noted in a person's body as they age. These changes are characterized by a progressive and cumulative generalized impairment of physiological functions. Some of which may be explained at least by genetic factors, multiple morbidities, and non-genetic factors such as nutrition, lifestyle, and physical activity.(1) These changes may eventually cause an increase in the risk of a person to develop chronic illness and to become dependent for care.(2)

Several problems in balance are no different from the changes in the physiologic functions of the body. These changes become more common as a person ages and eventually becomes the leading cause of falls. Falls increase the risk to acquire musculoskeletal conditions such as fractures and in severe cases, may even cause traumatic brain injury. It is expected in normal aging, that one will have a reduced ability to maintain posture while standing in either unipedal or bipedal stance, during normal or tandem walking, and when trying to avoid obstacles.(3)

For an individual to maintain posture, respond to voluntary movements, and even to react to external perturbations, balance is necessary.(4) To maintain this balance, one's center of mass must stay within the continuous changing base of support without any deformation or displacement of the base of support. This is identified as static postural control. In events of any deformation and/or displacement of the base of support, this condition is then referred to as dynamic postural control, which implies that the center of mass constantly remains above the base.(5)

Whole-body vibration has been recently recognized as a form of management as it shows an increasing role in increasing muscle performance and balance. Several studies have also shown that this type of management has a positive influence in reducing the risk factors of falling by improving muscle strength and have shown that whole-body vibration may be as effective as exercise. The theory used in these studies state that the use of the-whole body vibration will cause a continuous proprioceptive stimulation which increases neuromuscular receptivity.(6)

Vibration was found to activate the muscle spindles which induces reflex muscle activation and potentially result in muscle strength benefits. For this reason, whole-body vibration potentially increases the strengthening benefits of exercise. The vibration platform also provides an unstable surface for exercise to further challenge balance control. Therefore, when there is an increase in muscle contraction, the resistance is also increased which ultimately result in improving the muscle strength.(6)

Therefore, it is the objective of this study to identify whether the male and female population will

benefit from a therapy in the form of whole-body vibration (15 minutes per session for 8 sessions). The researcher hypothesizes that the respondents will benefit from the whole-body vibration, which in turn improves their balance.

Literature Review

Being able to balance, means that a person has the ability to control and maintain the body's line of gravity to its base of support in the presence of an external force. This maintenance of control over the external forces has to do with muscular synergy in humans that is an interplay between neurological and muscular systems.(1) Having good balance would mean that a person could perform the simplest activities such as standing, to more complex ones such as ascending and descending the stairs. With the diminished capacity to balance, comes the proportional chances of falling that increases the incidence of disability and even death. It may even possibly cause the loss of independence in most cases.

A person senses and rationally begin to make appropriate responses about the outer and inner environment and learn to be adapted and modified to the environment.(7,8) From an infant's ability to lift its head to a toddler being able to walk, these adaptations create sensory reweighting that under steady and increasing occurrences result in sensory unity in relation to weight that create torques to counteract oscillations of body swaying.(9) Although upon aging, and fluctuations of weight, muscular mechanical strains diminish strength of musculoskeletal tissues, resulting in tendon weakness and eventual loss of muscle and bones. Hence, the anatomical compromise creates physiological changes that influence decline of vestibular health. This proves the capacity of sensory challenges influencing the capacity to improve balance in persons on the need to improve ability to do activities of daily living. (10,11)

The body relies on a number of structures and mechanisms for controlling the transmission of impact shocks and vibrations through the body including: bone, cartilage, synovial fluids, soft tissues, joint kinematics, and muscle activity. Changes in joint kinematics and muscle activity can be regulated on a short time scale and used by the body to adjust its response to external forces through vibration.(12) Additionally, balance is influenced by the ability to structurally control posture. This is governed by either tonic muscle activity and external and internal perturbations.(13) One of these daily perturbations can be traced through gravity that we counteract that results in postural destabilization through the gravity attracting effect toward the center of the earth. It is known that this compensation promotes postural adjustments through highly-coordinated patterns of muscle activation and deactivation throughout the whole-body.(14)

The preference of humans to bipedal stance that favors mobility over stability challenges postural equilibrium that can be related back to constant challenges leading into a greater muscular control to influence balance.(13) This also relates to how increased mobility such as in younger individuals create a positive impact on their increased balance. Hence, this variable of a person's movement signifies differences in postural control throughout life is related to the capacity to perform activities of daily living with no problem.

Performing activities of daily living will require the use of balance. The ability to control balance would involve the coordination of different systems in the body, such as the somatosensory, vestibular, and visual systems. All of these systems work hand in hand with the neuromuscular system to maintain the center of mass of a person's body while controlling the line of gravity even in the presence of perturbations.(12) These perturbations create feedback to these sensory systems that would result to feedback controls that is dependent on the motions felt by the person that ultimately contributes to postural stability.(9) This means that an increased ability to establish postural control effects a person's ability to balance in the long run, and changes to such improves through life and as mentioned diminishes over aging.

Whole body vibration is a newly developed method in neuromuscular training. It was once used to improve speed-strength performance in some athletes. The mechanical stimuli produced by vibrations as the subject stands on the vibration plate will be transmitted into the body and will stimulate the muscle spindle sensory receptor. The stimulation of the receptors will then lead to the activation of motor neurons and this will initiate muscle contractions.(15) These muscle contractions that serve as both neuronal and muscular training increase the body's ability to generate muscular synergies that influence postural control that change the body's ability to balance.(1) The repeated muscle contraction creates multiple tensile stresses that increases the elastic potential energy of a muscle that influences control and production of kinetic energy used for ambulation that also has a balance component.(16)

Most studies on vibration as a treatment of different disorders aimed at increasing muscle strength, improving balance, and increasing bone mass.(17) Moreover, vibration training induces type II muscle fiber training depending on the frequency of vibration.(18) Such mechanical impulses are transmitted to the body where the sensory receptors, most likely muscle spindles, are activated in response. This results in stimulation of the alpha-motoneurons and initiates muscle contractions similar to the tonic vibration reflex.(15)

On this basis thereof, it was found out that as a long-term effect, vibration treatment decreases muscle mass and might cause bone atrophy in the younger people.(17) Contrary to that statement, in the elderly without any comorbidities, vibration as a treatment have shown improvements on muscle performance and balance. As a result, the frequency of falls of the subject will decrease.(19) Moreover, in postmenopausal women, low intensity vibration improves balance, mobility and muscle strength in the upper and lower limbs.(20) While in healthy young men who use indirect calorimetry to gauge oxygen consumption have shown that vibration exercises raise the metabolic expense of exercise that can be complemented in several settings by physical activity programs.(21)

In the assessment of balance, one must take note of all the strategies a person uses in the presence of a change in the support and the condition of the sensation and proprioception of the patient. Assessing the balance of a person is important. The result of assessing one's balance would indicate a problem in balance and whether a patient would need to be referred to treatment. (22) Furthermore, Balance tests will evaluate how balance approaches change with changes in support and sensory environments, changes in attitudes and perceptions of a person and changes in task constraints. (23) This research uses two assessments for balance for each of the respondents, the Functional Reach Test (FRT) and the Timed Get-Up-and-Go Test (TUG).

The Functional Reach Test, (FRT) calculates the difference between the arm length and the average forward reach in the standing position while retaining a fixed support base. It was developed as a dynamic balance measure, without attempting to control the movement strategy.(24) It is also used to know how far a person can go voluntarily, by shifting the Center of Gravity with his feet stationary to the limited base of support.(25)This is an easy and inexpensive tool used to assess limits of stability in the forward direction.(26) Adults often overestimate their ability to reach forward that results into a change in postural stability. This overestimation of forward reach coupled with reduced postural limits may cause loss of balance in older adults.(25)

The Timed-Up and Go Test where subjects are seated in a freestanding chair and were asked to stand, required to walk a 3-meter distance, and then turn around and walk back to the chair and sit down. The time was measured in seconds from rising from the seat to making contact with the back of the seat.(27) It tests the balance as well as the functional mobility especially in the population of the elderly. According to studies, the functional mobility of the patient is highly correlated with the result of the test.(28)

Aside from being able to assess cognitive impairments, the most important point for assessment in the TUG is its ability to predict incidences of falling not only in the elderly but even in young adults. TUG

test is noted as a better method to assess falls, as its test components include sit-to-stand, walking and turning motions and are related to falling.(29) Multifactorial causes of falling include extrinsic (environment-related), intrinsic (person-related), and behavioral (activity-related) influences.(30) Such as uneven surfaces, frailty of age that presents postural control impairments, and doing activities of daily living. Furthermore, the National Institute of Clinical Evidence (NICE) also recommend the use of the TUG to test gait and balance in the prevention of falls in older people.(23)

Having established that balance and postural stability is learned and trained through internal and external perturbations, and that neuromuscular strengthening is needed to increase postural stability, it is established that exercises will ultimately improve balance and stability especially in the elderly which has an increased risk for falls. Progressive strength training created significant strength gains in the elderly, with no experience in this type of training, and enhanced static and dynamic balance performance as a result of these gains. Therefore, we can conclude that the training program caused changes in daily activity activities efficiency and reduced the risk of falling.(31) With proper functioning of the spinal reflex, brain stem control and cognitive training, the correct muscle responses will occur and muscle stimuli can thus boost functionality.(21)

Current evidence shows that whole-body vibration treatment may be a successful workout technique to reduce the effects of the musculoskeletal ageing process. Vibration might also tend to be an efficient countermeasure to microgravity and disuse.(21) As an alternative to physical activity and exercise, this whole-body vibration approach is great to help improve physical fitness and enhance general health of elderly people.(32) Furthermore, studies have presented that older adults have higher cooperation to whole body vibration training compared to other exercises for they seem to favor its simplicity. Patients both old and young also seem to quickly adapt to the vibration training and already feel comfortable even at the second treatment day.(18)

Reasoning from that fact, literature has proven that there is a direct correlation between improving balance through the use of whole-body vibration training. Although studies have been limited to the use in older adults, the training can be used by untrained or injured individuals given the proven effects it may cause. Young adults may present with more acute effects to this training but that does not mean that they won't benefit from its long-term effects in the future. Whole vibration therapy could be adjunct to young adult exercises as its effects would not be sufficient enough to elicit acute improvements. Conversely, in older adults, the training has been proven to show increase in balance, proprioception, and muscular strength and endurance that is needed to prevent falls.

Moreover, the newly gained neuromuscular training that resulted from the whole-body training will not only improve the balance and proprioception but make sure that the body's internal synergies for postural control is trained as well. This now will improve the quality of living in both young adults and older adults by just improving how mobile they can be in their activities of daily living and by obtaining confidence in doing these activities of daily of living just by the reduced risk of falls through the postural and dynamic stability training brought by the whole-body vibrations.

In this regard, both the young and old population due to the equal effects of the whole-body vibration to them, being the improvement in neuromuscular system, balance and proprioception will greatly benefit from the training. The Functional Reach Test and Timed Up and Go Test being balance assessment tools, also give both stable and dynamic visual assessment for balance and its multitude of factors.

Research Objectives

This research study aims to determine whether male and female individuals improve their balance after whole-body vibration.

Specifically, the thesis aimed to:

1. Improve the balance of the subjects after undergoing whole-body vibration.

Research Hypothesis

HA: There is an improvement in the balance of the respondents after undergoing whole-body vibration, specifically that their post-test scores on both TUG and FRT be greater than the pre-test scores.

H0: There are no improvements in the balance of the respondents after undergoing whole-body vibration, specifically that their post-test scores on both TUG and FRT be equal or lesser than the pre-test scores.

Method

The study was conducted to study the effectiveness of whole-body vibration on the balance of different age groups. The result of this study will benefit different rehabilitation centers and also the geriatric population, whose balance deteriorates through time. If proven, vibration plate therapy will be

considered as an option intreating the balance problems. The outcome of this research will also become a guide and a foundation for future researchers who are interested in studying whole body vibration and improving balance of different age groups.

This research project subscribes to the ethical principles of the conduct of research involving human subjects mandated by the Philippine Health Research Ethics Board and relevant national and international organizations. It was approved by the Southwestern University PHINMA Research Integrity Board on December 7, 2019. Informed Consent Forms were provided, verbally explained, and signed by the respondents prior to the start of involvement in the study.

A total of PHP 790.00 was spent on this research. All expenses were funded by the researchers and were not sponsored nor affiliated to any organization or institution.

Selection and Description of Participants

Participants that were used to conduct this research was a combination of both male and female individuals with ages 18 and above from Cebu, Philippines. For individuals who were currently experiencing any illness, diagnosed with any chronic musculoskeletal, neurological, or vascular disease were excluded from the research study.

Technical Information

After qualified subjects were gathered, a printed copy of the informed consent form was distributed. After which, the subjects underwent an assessment of balance with the use of the Timed-Up and Go Test and Functional Reach Test.

In the Timed-Up and Go Test, the respondent was asked to sit on a chair. Once the examiner gave the "Go" signal, the subject stood up and walked in a three-meter line, turned around and sat back on the

chair. The examiner started to record the time the moment the subject stood up and stopped once the subject returned to a sitting position. The recorded time was noted as the pre-TUG score.

For the Functional Reach Test, the respondent was asked to stand by the wall with a tape measure mounted on it, at the height of the acromion. The subject was asked to reach with one hand at 90 degrees shoulder flexion, elbow fully extended, and hands forming a fist. Reach distance was measured as the displacement of the 3rd metatarsal head between initial position and end position. The recorded distance was noted as the pre-FRT score.

The respondents received a 15-minute whole-body vibration therapy for 8 sessions. After the subject completes 8 sessions, subjects underwent another set of Timed-Up and Go Test and Functional Reach Test which was identified as the post-TUG and post-FRT scores, respectively.

Statistics

The G-power 3.1.9.4 application was used in determining the sample size of this research. The type of power analysis used was a priori: compute required sample size – given α, power, and effect size. The statistical test used was the difference between two independent means (two groups). The result from the application showed to have a sample size of 20. The standard values were dependent on the research representative study: Strength Increase after Whole-Body Vibration Compared with Resistance Training.

The research uses a two tailed paired t-test to test the two hypotheses as mentioned before. Data collected was then tabulated and run through the IBM SPSS software, this allowed for reliable results and faster analysis of the data.

Results

Results between Pre-TUG and Post-TUG and between Pre-FRT and post-FRT

Paired T-tests for the Timed Up and Go Tests with alpha level ($p < 0.05$, $t = -8.665$) with mean difference of 0.54 (SD=0.28) and the paired t-test for the Function Reach Test with alpha level ($p < 0.05$, $t = -10.389$) with mean difference of 0. 74 (SD=0.32). Collected data for the specific tests are found in Appendix A (Table 2 and 3).

Appendix A (Table 1) clearly signifies the difference between the scores on both the TUG and FRT. The mean differences between the pre-test and post-test on the respective assessment tools means their post-test scores were significantly greater than their pre-test scores. This then can imply that the researchers have proven their hypothesis to be correct that whole-body vibration can improve the balance of the individuals.

Comparison between age and post-WBV results

Statistical data treatment showed mean age of 52.30 (SD = 19.33) this is noting that this research was limited to a sporadic distribution of age. A correlation between age and post-whole-body vibration was performed. Across conditions as the age increased their post-intervention TUG scores, ($r=0.52$, $p=0.02$), and post-whole-body vibration FRT scores ($r=-0.62$, $p<0.01$) also increased. This would imply a positive correlation between the two variables which could be explained by presented literature. Although this research is limited to a sporadic distribution of age, we can see that WBV can still improve the balance of individuals.

Discussion

This is quasi experimental within group research composed of 20 participants, 14 of which are females and 6 of which are males, who underwent 8 sessions of 15 minutes of whole-body vibration treatment in a span of two months with mean age of 52.30 (SD = 19.33). This sample size computed through G-

power 3.1.9.4 application has a 95% confidence level. Data was run through the IBM SPSS software using paired t-test. Statistically, the mean differences and t-test result show the significant improvement of the recorded data between the pre-test and post-test with alpha level ($p < 0.05$, $t = -8.665$) with mean difference of 0.54 (SD=0.28) and the paired t-test for the Function Reach Test with alpha level ($p < 0.05$, $t = -10.389$) with mean difference of 0. 74 (SD=0.32), while the post-WBV values run against the ages has also shown a positive correlation. Clinically, the significant improvement in the post-test scores on both the TUG and FRT really shows that WBV has helped in improving the balance of individuals, even in the older age group population where balance is naturally depleting. That also means that WBV even though is a static treatment can also improve dynamic balance that is exhibited in the TUG test. Although this research had a limited age group demography and the research was not able to establish the difference of the effect of WBV on males and female due to the unequal distribution of difference in the sexes of the participants.

References

1. Wojtara T, Alnajjar F, Shimoda S, Kimura H. Muscle synergy stability and human balance maintenance. J Neuroeng Rehabil. 2014;
2. Moya Rodrigues Pereira N, Eduardo Scheicher M. Postural Imbalance in the Elderly: Main Aspects. In: Geriatric Medicine and Gerontology. 2019.
3. Osoba MY, Rao AK, Agrawal SK, Lalwani AK. Balance and gait in the elderly: A contemporary review. Laryngoscope Investig Otolaryngol. 2019;
4. Matsumura BA, Ambrose AF. Balance in the Elderly. Clinics in Geriatric Medicine. 2006.
5. Paillard T. Relationship between muscle function, muscle typology and postural performance according to different postural conditions in young and older adults. Frontiers in Physiology. 2017.
6. Spiliopoulou SI, Amiridis IG, Tsigganos G, Economides D, Kellis E. Vibration effects on static balance and strength. Int J Sports Med. 2010;
7. Değer TB, Saraç ZF, Savaş ES, Akçiçek SF. The relationship of balance disorders with falling, the

effect of health problems, and social life on postural balance in the elderly living in a district in Turkey. Geriatr. 2019;

8. Konrad HR, Girardi M, Helfert R. Balance and aging. Laryngoscope. 1999;
9. Mahboobin A, Loughlin PJ, Redfern MS, Anderson SO, Atkeson CG, Hodgins JK. Sensory adaptation in human balance control: Lessons for biomimetic robotic bipeds. Neural Networks. 2008;
10. Goldspink G. Age-related loss of muscle mass and strength. Journal of Aging Research. 2012.
11. Box 13305 PO, Portland ·. Balance and Aging [Internet]. [cited 2020 Sep 29]. Available from: www.vestibular.org
12. Nigg BM. Impact forces in running. Current Opinion in Orthopaedics. 1997.
13. Ivanenko Y, Gurfinkel VS. Human postural control. Frontiers in Neuroscience. 2018.
14. Yiou E, Hamaoui A, Allali G. Editorial: The contribution of postural adjustments to body balance and motor performance. Frontiers in Human Neuroscience. 2018.
15. Delecluse C, Roelants M, Verschueren S. Strength increase after whole-body vibration compared with resistance training. Med Sci Sports Exerc. 2003;
16. Albasini A, Krause M, Rembitzki IV. Using whole body vibration in physical therapy and sport. Using Whole Body Vibration in Physical Therapy and Sport. 2010.
17. Rauch F. Vibration therapy. Developmental Medicine and Child Neurology. 2009.
18. Rittweger J, Beller G, Felsenberg D. Acute physiological effects of exhaustive whole-body vibration exercise in man. Clin Physiol. 2000;
19. Bogaerts A, Verschueren S, Delecluse C, Claessens AL, Boonen S. Effects of whole body vibration training on postural control in older individuals: A 1 year randomized controlled trial. Gait Posture. 2007;
20. Dutra MC, De Oliveira ML, Marin R V., Kleine HCR, Silva OL, Lazaretti-Castro M. Whole-body vibration improves neuromuscular parameters and functional capacity in osteopenic postmenopausal women. Menopause. 2016;
21. Sá-Caputo D, Paineiras-Domingos LL, Francisca-Santos A, Dos Anjos EM, Reis AS, Neves MFT, et

al. Whole-body vibration improves the functional parameters of individuals with metabolic syndrome: An exploratory study. BMC Endocr Disord. 2019;

22. NCT01702597. WBV and Acute Lateral Ankle Sprain. The Effect of Whole Body Vibration and Acute Unilateral Unstable Lateral Ankle Sprain - A Biphasic Randomized Controlled Trial -. 2012.
23. Ibrahim A, Ajit DKS, Shahar S, Omar MA. Timed up and go test combined with self-rated multifactorial questionnaire on falls risk and sociodemographic factors predicts falls among community-dwelling older adults better than the timed up and go test on its own. J Multidiscip Healthc. 2017;
24. Johnsson E, Henriksson M, Hirschfeld H. Does the functional reach test reflect stability limits in elderly people? J Rehabil Med. 2003;
25. Newton RA. Validity of the multi-directional reach test: A practical measure for limits of stability in older adults. Journals Gerontol - Ser A Biol Sci Med Sci. 2001;
26. Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: A new clinical measure of balance. Journals Gerontol. 1990;
27. Cardinale M, Wakeling J. Whole body vibration exercise: Are vibrations good for you? [Internet]. Vol. 39, British Journal of Sports Medicine. Br J Sports Med; 2005 [cited 2020 Sep 29]. p. 585–9. Available from: https://pubmed.ncbi.nlm.nih.gov/16118292/
28. Robbins S, Waked E, Mcclaran J. Proprioception and stability: Foot position awareness as a function of age and footware. Age Ageing. 1995;
29. Ibrahim A, Singh DKA, Shahar S. 'Timed Up and Go' test: Age, gender and cognitive impairment stratified normative values of older adults. PLoS One. 2017;
30. Donoghue OA, Horgan NF, Savva GM, Cronin H, O'Regan C, Kenny RA. Association between timed up-and-go and memory, executive function, and processing speed. J Am Geriatr Soc. 2012;
31. Sousa N, Sampaio J. Effects of progressive strength training on the performance of the functional reach test and the timed get-up-and-go test in an elderly population from the rural north of Portugal. Am J Hum Biol. 2005;

32. Awan RI, khan N, Perveen S. The Effect of WBV on Balance, Mobility and Strength in Aging Adults: A Systematic Review. Biol Syst Open Access. 2017;

Appendix A: Tables and Figures

Table 1. Paired Sample T-test for TUG and FRT across Pretest and Posttest

	t	Mean	SD
Pre-TUG & Post-TUG	-8.665	0.54	0.28
Pre-FRT & Post-FRT	-10.389	0.74	0.32

Table 2. Timed-Up and Go Data

Respondents no.	Age	Sex	Pre-TUG	Post-TUG	Difference
1	68	F	12.9	12.5	0.31
2	65	F	12.27	12.4	0.13
3	78	F	12.84	13.02	0.18
4	76	F	16.6	17.1	0.5
5	70	F	12.2	12.95	0.75
6	68	F	13.7	14	0.3
7	59	F	13.28	14	0.72
8	60	F	10.2	10.8	0.6
9	68	M	9.54	10.32	0.78
10	68	M	13.05	13.23	0.18
11	65	M	16.2	16.43	0.23
12	37	F	10.8	11.52	0.72
13	22	F	9.34	10.43	1.09
14	21	M	8.04	9.1	1.06
15	50	M	11.06	11.67	0.61

16	29	F	10.81	11.21	0.4
17	51	F	9.12	9.85	0.73
18	29	M	11.2	11.9	0.7
19	28	M	13.15	13.7	0.55
20	34	F	12.15	12.5	0.35

Table 3. Functional Reach Test Data

Respondents no.	**Age**	**Sex**	**Pre FRT**	**Post FRT**	**Difference**
1	68	F	18.5	19	0.5
2	65	F	17.5	17.9	0.4
3	78	F	10.5	10.9	0.4
4	76	F	12	12.5	0.5
5	70	F	16.5	17.2	0.7
6	68	F	17.5	17.9	0.4
7	59	F	20.5	21.2	0.7
8	60	F	23.5	24	0.5
9	68	M	25	25.9	0.9
10	68	M	15.5	15.7	0.2
11	65	M	25	25.8	0.8
12	37	F	23.5	24.8	1.3
13	22	F	20.5	22	1.5
14	21	M	23.5	24.4	0.9
15	50	M	18	18.8	0.8
16	29	F	23	24.1	1.1
17	51	F	21.5	22.3	0.8

18	29	M	23.5	24.2	0.7
19	28	M	22	22.8	0.8
20	34	F	21.5	22.4	0.9

