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ORIGINAL ARTICLE

Effects of Whole Body Vibration on Functional Independence in Older Adults

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Author`s Contribution

[1-3]Conception and design, [2-3] Collection and assembly of data, [2-1]Analysis and interpretation of the data, [3]Critical revision of the article for important intellectual content, [2] Statistical expertise,[1]Final approval and guarantor of the article.

Article Info.

Received: January 3, 2023
Acceptance: July 27, 2023

Conflict of Interest: None
Funding Sources: None

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Cite this article as: Khan E, Mehmood Z, Shafiq M, Khalid M, Iqbal H Hussain MA Effects of Whole Body Vibration on Functional Independence in Older Adults,. JRCRS. 2023; 11(4):235-239
DOI:https://dxdoi.org/10.53389/JRCRS.2023110409

A B S T R A C T

Objective: To determine the effects of whole body vibration along with balance training in older individuals.

Methodology: This randomized control trial was conducted on total of 112 participants were recruited on the basis of inclusion criteria of both genders with controlled diabetes and hypertension, age ranging from 50 to 70 years, medium fall risk according to Berg balance score of 21-40. Patient with any type of surgical intervention which may hinder assessment or treatment, Individuals were randomly assigned to experimental (n=56) and control groups (n=56) through toss a coin method. Experimental group was given balance and strengthening exercises with whole body vibration whereas, control group received balance and strengthening exercises only. Individuals in both groups were assessed for their balance performance by using Berg Balance Scale, Functional Independence Scale, and Time Up and Go Test. These assessment tools were used before and after the treatment of 4 weeks' protocol.

Results: Mann-Whitney U test was applied for comparison between control and experimental group. The p-values of Berg balance and functional independent measure were 0.001 and 0.003 respectively with statistically significant improvement whereas time up and go test showed statistically non-significant results with the p value 0.044 (less than 0.05)

Conclusion: This study concluded that Whole body vibrations along with balance training and strength were more effective in improving functional independence when compared to conventional physical therapy exercises training for strength and balance.

Clinical Trial Number: NCT04963387

Key words: Diabetes, Functional Independence, Hypertension, Strength Training, Vibration.

Introduction

All human beings are vulnerable to musculoskeletal issues and other health problems in life, but elderly population is much more prone to such problems.[1] One of the concerned problem in improving and maintaining a healthy life among the older individuals is independence in daily life activities.[2] According to a survey conducted in 2010, Pakistani demographics showed that older population of age more than 60 years has been increased by 75.1%.[3] By 2023, life span is expected to be increased upto 72 years. A report conducted by WHO in 1998 concluded that Pakistan 60+ aged population was 5.6 % with the possibility of doubling to 11 percent by the year 2025.[4] In the developing countries of the world the ratio of elderly population is particularly increasing day by day. It is expected that by 2050 world will have less children of age 15 years and will have more elderly (60+ and above). The main cause behind the increase in aged population is due to advancement in the field of medicine which leads to reduce mortality rate.[5]

Decrease in muscle mass indicates decline in muscular efficiency and strength leading inability to produce rapid forces known to be an essential component for functional performance, thus the risk of fall increases in elderly population. Falls may lead to fractures subsequently declining the overall life quality and increasing the levels of disability. [3]

Studies on whole body vibration intervention have shown to improve strength among healthy adults and older populations. Furthermore, Whole Body Vibration has been reported to decrease pain and disability in individuals with chronic low back pain. Whole body vibration (WBV) has been introduced as an effective, safe and a low contact exercise. Furthermore, a body vibration exercise appears to be helpful in prevention of muscle and bone degeneration among adults with limited range of motion and exercise capacity. [6]

An experimental study was carried out to identify the special effects of task related exercises with whole body vibrations (WBV) on the sitting balance of stroke individuals. Results of their research concluded that task-oriented training with WBV was reasonable and efficient for patients with stroke.[7]

Exercises with whole body vibration are identified to decrease Hoffman reflex and excitation of central motor neurons in healthy older individuals. Training with WBV can cause presynaptic inhibition of both nociceptive and motor neurons that reduced pain threshold.[8]

A whole-body vibration (WBV) training program was proposed as a training program to enhance physical function in the older adults. During WBV training, the participants stand on a platform that produces vertical sinusoidal vibration at a frequency between 35 and 40 Hz. These mechanical stimuli were transferred in the body where they excite sensory receptors, most possibly muscle spindles. This causes the commencement of the alpha-motor neurons and stimulation of contractions in muscles like “tonic vibration reflex”.[6] Numerous researches evaluated the impact of WBV on muscular strength, functional performance and balance, and showed significant improvements. WBV has been found to progress walk and stability in individuals with several disease conditions, for instance stroke, cerebral palsy and multiple sclerosis.[5,6] Literature has shown that some of the studies have investigated the outcomes of WBV therapy on ADLs among elderly population with disease, few of them have also documented the significant results.

However, up to our knowledge the combination effect of “whole body vibration” and strengthening exercises on physical functioning and balance in normal older adults has not been studied yet. Therefore, this study aimed to evaluate the effects of whole body vibration on functional performance in older adults with strengthening and balance exercises.

Methodology

All human beings are vulnerable to musculoskeletal issues and other health problems in life, but elderly population is much more prone to such problems.[1] One of the concerned problem in improving and maintaining a healthy life among the older individuals is independence in daily life activities.[2] According to a survey conducted in 2010, Pakistani demographics showed that older population of age more than 60 years has been increased by 75.1%.[3] By 2023, life span is expected to be increased upto 72 years. A report conducted by WHO in 1998 concluded that Pakistan 60+ aged population was 5.6 % with the possibility of doubling to 11 percent by the year 2025.[4] In the developing countries of the world the ratio of elderly population is particularly increasing day by day. It is expected that by 2050 world will have less children of age 15 years and will have more elderly (60+ and above). The main cause behind the increase in aged population is due to advancement in the field of medicine which leads to reduce mortality rate.[5]

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However, up to our knowledge the combination effect of "whole body vibration" and strengthening exercises on physical functioning and balance in normal older adults has not been studied yet. Therefore, this study aimed to evaluate the effects of whole body vibration on functional performance in older adults with strengthening and balance exercises. Randomized control trial was conducted after the approval of Research Ethical Committee of Riphah International University (RCRS/REC/Letter-00517).

Results

Total of 112 participants were recruited in the trial with 56 individuals in each group. Although 56 participants were placed in each group but 4 participants from the control group and 8 from the experimental group were excluded from the study because of unwillingness to participate in study.

To determine the normality of data, Shapiro Wilk test was applied on the baseline variables of berg balance score, time up and go and functional independence scale and its p value less than 0.05 that showed the data was not normally distributed so the test of choice was non parametric i.e. MannWitney U test for the comparison between two groups.

The mean age and standard deviation of participants was 57±5.08 and demographic of gender variables of both control and experimental group are shown in table I

Table I: Percentage of participants in Control and Experimental group.

Gender	Frequency (%)
Male in experimental group	31 (64.6%)
Females in experimental group	17(35.4 %)
Male in control group	23 (44.2 %)
Females in control group	29 (55.8%)

Mann Whitney U test was applied for inter group analysis, its Median (IQ), Z value and mean rank values are shown in Table II. P-value for the pre TUG control and experimental group was 0.76 whereas post TUG P value between both groups was 0.44 that showed statistically non-significant improvement between the two groups whereas p-value of BBS for the pre and post control and experimental group were 0.277 and 0.001 and statistically significant difference was found between the two groups. P-value for pre and post FIM control and experimental group were 0.741 and 0.003 respectively that also showed statistically significant improvement between groups.

Table II: Mann Whitney U test for between group analysis.

Variable	Group	Median(IQ)	Mean Rank	Z value	P-value
Pre TUG	Control	12.09(3.38)	45.56	-1.77	0.76
	Experimental	13.45(3.80)	55.85		
Post TUG	Control	12.04(4.00)	56.11	-2.013	0.44
	Experimental	11.00(4.07)	44.43		
Pre BBS	Control	37.50(4.00)	53.51	-1.087	0.277
	Experimental	36.0(6.75)	47.24		
Post BBS	Control	38.00(3.00)	33.91	-5.96	0.001
	Experimental	45.00(8.00)	68.47		
Pre FIM	Control	122.50(6.00)	49.59	-.330	0.741
	Experimental	121.50(5.00)	51.49		
Post FIM	Control	123.00(5.00)	42.32	-2.989	0.003
	Experimental	125.0(3.00)	59.36		

Discussion

The primary findings showed that whole body vibration technique was beneficial in improving balance and functional mobility in older adults and can be helpful in preventing falls in elderly population. Comparison between pre and post-test of TUG showed that there was statistically non-significant improvement between the groups with p value greater than 0.05. BBS was used to assess the functional balance performance in elderly showed statistically significant improvement in post assessment with the p value 0.001 and the last variable FIM used for evaluation of functional status in elderly also showed statistically significant improved results with the p value 0.003. The results of the study reported that whole body is effective in improving balance and functional mobility in older adults and can be helpful in preventing falls in elderly population.

Various studies have confirmed that whole body vibrations have positive effects on balance in elderly. A randomized control trial was conducted by Eon-Tak Choi, and Yong-Nam Kim, et al in physical therapy department in Korea. Its results showed that whole body vibration had significant effects on balance and gait parameter of patients with stroke. These results are similar with our study results in terms of improvement in balance.[9] however a systematic review conducted in 2016 by Anwer et al. showed non-significant effect of WBV on quadriceps muscle strength in patients suffering from knee osteoarthritis.[10]

In 2019 a systematic review and meta-analysis of randomized controlled trial was conducted by Dong, Yulin, to examine the influence of whole body vibration (WBV) on patients with for chronic musculoskeletal pain: Thus WBV can be suggested for the reduction of the pain in lower back region and improvement in balance ability of patients.[11] The study results are in favor of our study results as whole body vibrations significantly improved balance of participants.

This study also concluded that whole body vibration caused much improvement in functional performance. In Brazil , a research was performed by Coelho-Oliveira et al to assess functional performance in individuals with rheumatoid arthritis (RA).The objective of their trial was to determine the effects of "whole body vibration" exercise in subjects with constant, well-known RA. 21 women with RA The study results showed significant enhancement in functional performance occurred in the WBV group.[12] The study results are incoherent with our study results as whole body vibrations significantly improved functional performance on functional independent measure.

Another RCT was conducted by Mikami, Y., Amano in 2019 on 28 adult female with 14 being in interventional group and 14 in control group. Two sets of mobility training twice a day and three times a week for 12 weeks were conducted and a statistically significant improvement was seen in the group who received WBV after the training program of dynamic balance, knee muscle strength and mobility function.[13]

Decline in participation occurred because individuals refused to stand on whole body vibrator. In this study individuals with moderate risk of fall that is BBS (21 to 40) were only included. Further this study included healthy individuals only but it could also have more beneficial effects on mild muscular weakness and patients with sub-acute and chronic stroke impairments.

Conclusion

This study concluded that whole body vibrations in combination with strength and balance training were more effective in improving balance and functional mobility in older adults and can be helpful in preventing falls in elderly population as compared to conventional physical therapy exercises for strength and balance.

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