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Effect of Whole Body Vibration versus Aerobic Exercise on Arterial Stiffness in Elderly

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Abstract : Background and Objective: The purpose of the study was to detect the effect of whole body vibration versus aerobic exercises on arterial stiffness in elderly. **Material & Methods:** Forty elderly patients was selected from both sexes and their age was ranged from 60 to 70 years and they was divided into two equal groups: **Group (A)** Twenty patients was selected from both sexes (equal in number) was performed whole body vibration (WBV) exercise &**Group (B)** Twenty patients was selected from both sexes (equal in number) was performed Aerobic exercise. The program was 3 times per week and for 8 weeks. Arterial stiffness was measured by brachial& ankle Pulse Wave Velocity (baPWV) 3 times throughout the program. **Results:** In Group (A) when post treatment results compared with pretreatment results there was a significant decrease in Brachial PWV by 11.84% and Ankle PWV there was a significant decrease by percent of change was 7.7%. In Group (B) when post treatment results compared with pretreatment results there was a significant decrease in Brachial PWV by 9.44% and Ankle PWV there was a significant decrease by percent of change was 8.6%.while Group A results versus Group B results there was NO significant difference in mean values of baPWV.**Conclusion:** There was a significant decrease in both groups in baPWV values. But when comparing result of Group (A) versus Group (B) there was NO significant difference in mean values of baPWVso both modalities had same decreasing effect on arterial stiffness.
Key word : Whole Body Vibration, Aerobic exercise, Arterial stiffness, Elderly.

Introduction

Pulse wave velocity (PWV) parameters are considered the gold standard for assessment arterial stiffness and are the best choice for prediction of cardiovascular diseases especially in persons considered high-risk patients like elderly and hypertensive patients[1].

When patient get elderly there are changes in the arterial system these changes affect the elasticity and its ability to expand against blood wave and this called arterial stiffness. This process will be propagated faster when the person has another factor that propagates arterial stiffness with aging[2].

Many factors, when combined with the aging process, will accelerate changes in arterial wall characteristics and speed up atherosclerotic process & arterial stiffness. These factors are like hypertension, diabetes mellitus, metabolic syndrome, smoking, obesity, hereditary factors, high lipid profile, and decrease elastin and increase collagen inside artery which leads to media thickening and increases artery stiffening[3].

Arterial stiffness is a term that describes elastic properties of the arteries and the compliance. Arterial stiffening is divided into two process arteriosclerosis and atherosclerotic process. The atherosclerotic process describes the deposition and obstructive prose in the artery while arteriosclerosis describes changes in the morphology and degeneration in-wall component [4].

Whole body vibration (WBV) is a new exercises modality that has an effect on many Field's like decrease blood pressure, improve arterial properties and elasticity, improve muscle properties like power, strength, and mass and improve bone density [2].

The effect of WBV on brachial-ankle pulse wave velocity (baPWV) still unknown and a few studies found the acute cardiovascular responses to WBV on baPWV [5].Aerobic exercises decrease arterial stiffness in the peripheral artery than central artery so the baPWV decreased in response to aerobic exercises better than carotid-femoral pulse wave velocity (cfPWV) [6].

Scientist found that aerobic exercise training is a better effect on reducing arterial stiffness than resistance training that found increased baPWV after training [7].The aerobic exercise improves general health, blood pressure, blood glucose, cardiovascular risk factors, and mortality rate. Aerobic exercise performed on many machine types like on the treadmill, cycle ergometer or walking, distance running and swimming [8].

The purpose of the study was to detect the effect of whole body vibration versus aerobic exercise on arterial stiffness in elderly.

Material and Method

Forty elderly patients from both sexes 20 men and 20 women. Their age was ranged from 60 to 70 years and they were under medical control and tested for 8 weeks and the study was conducted at department of physical therapy in medical Center Nasr city Area sixth and al-Mataria teaching hospital.

Inclusion criteria:

- Hypertension Systolic blood pressure(140-160) mmHg and Diastolic blood pressure(90-100) mmHg
- All subjects took stable (> 1 year) antihypertensive medication at the time of enrollment and continued the treatment throughout the study period.
- Body mass index for patients will be ranged from (30 to 34.9) Kg/m^2 BMI class I obesity.
- Non smoker
- Sedentary life < 90 minutes of regular exercise per week
- Their age was ranged from 60 to 70 years

Exclusion criteria: All patients had any of the following diseases was not be included in this study as:-

- Hepatic diseases.
- Diabetic neuropathy disease.
- Unstable Cardiovascular and pulmonary disease
- Cancer diseases.
- Renal failure disease.

- Recent surgery.
- Neurological disorder.

Design of study: Forty elderly patients was classified randomly into 2 equal groups in number: - Group (A) Consisted of twenty patients performed whole Body Vibration on (crazyvit exercise machine) divided into (10 men and 10 women) for 8-week program (3 sessions per week).Group (B) Consisted of twenty patients performed aerobic exercises on an electrical motorized treadmill (Profit exercise machine) Divided into (10 men and 10 women) for 8-week program (3 sessions per week).

Procedure: All patients signed informed consent for the purpose and nature of the study. A complete explanation, past history taken, medical examination and collected before the program started**.**

Evaluation process: The evaluation procedure had been done for both group patients.

1. Weight and height scale
2. Blood pressure measurement.by Sphygmomanometer
3. Time of session measured by device watch.
4. BaPWV measured by Arterial Duplex (General Electric F8 series) 3 times.

- 1st Measure was Taken before start program
- 2nd Measure during 4th week
- 3rd Measure after finish program at 8th week

Treatment process:

The program of the study had given 2 equal groups (A and B) 3 sessions per week and last for 8 weeks.

Group (A): It were conducted 3 times per week for 8 week, training used WBV. The program was subdivided into 3 phases, the warm up phase for 5 minutes, the main exercise phase 15-20 minutes with vibration intensity was 25–30 Hz and 1–2mm amplitude and third phase was the cool down phase for 5 minutes.

Group (B): It were conducted 3 times per week for 8 week, training used electrical motorized treadmill machine. The program was subdivided into 3 phases, the warm up phase for 5 minutes, and the main exercise phase 15-20 minutes.

Data analysis:

All statistical tests were performed through the statistical package for social studies (SPSS) version 19 for windows. (IBM SPSS, Chicago, IL, USA).

- Descriptive statistics and t-test were conducted for comparison of the mean age, weight, height, and BMI between both groups.A T-test was conducted for comparison of pre and post treatment between both groups.
- Paired t-test was conducted for comparison between pre and post treatment measures in each group.
- ANOVA with repeated measures test for comparison between pre, mid, and post treatment measurements in each group. The level of significance for all statistical tests was set at $p < 0.05$.

Results:

Table 1 showed Patients demographic data for mean ± SD age, weight, height, and BMI for both groups A & B. Comparing the demographic data of the subjects of both groups revealed that there was no significance difference between both groups in the mean age, weight, height, and BMI ($p > 0.05$).

Table 1. Descriptive statistics and t-test for comparing the mean age, weight, height, and BMI of both groups (A and B).

	Group A	Group B	MD	t- value	p- value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD				
Age (years)	60.3 ± 4.3	61.9 ± 4.27	-1.6	-1.17	0.24	**NS**
Weight (kg)	83.45 ± 10.09	80.75 ± 8.34	2.7	0.92	0.36	**NS**
Height (cm)	164.75 ± 7.15	163.2 ± 6.31	1.55	0.72	0.47	**NS**
BMI (kg/m²)	30.85 ± 4.17	30.37 ± 3.33	0.48	0.39	0.69	**NS**

$\overline{X}$: Mean **SD: Standard Deviation** **MD: Mean difference**

t value: Unpaired t value **p value: Probability value** **NS: Non significant**

Table 2 represent the Pretreatment mean values of brachial and ankle PWV of both groups (A and B) and it showed that there was no significant difference in brachial PWV between group A and B pretreatment. Also, table 2 represent the mean ± SD and comparison between (pre, mid and post) treatment mean values of brachial and ankle PWV of group A & B and showed Comparison between (pre, mid and post) treatment values.

Group A baPWV values were mentioned in table 2 and showed the difference between (pre and mid) treatment values and the difference between (pre and post) treatment results.Also,it showed the percent of change between them and the comparison between (post and pre) treatment and (mid and post) treatment results.

Also Table 2represent the mean ± SD of Group B baPWV (pre, mid and post) treatment values and the Comparison between (pre, mid, and post) treatment measures showed a difference in the brachial PWV measures between the three time intervals, also when comparing the (pre and mid) treatment values in group B the percent of change between them it was 4.21% while it showed a significant decrease in the comparison between (pre, mid and post) treatment values in the brachial PWV measures.

Table2ANOVA with repeated measures for comparison between pretreatment, midtreatment and posttreatment mean values of brachial and ankle PWV of group A& B:

		Brachial and ankle PWV (m/s) $\overline{X}$ ±SD			F- value	p- value	Sig
		Pre treatment	Mid Treatment	Post Treatment			
Group A	**Brachial**	14.27 ± 3.31	13.33 ± 2.89	12.58 ± 2.53	25.41	0.0001	**S**
	Ankle	14.41 ± 3.95	13.94 ± 3.55	13.3 ± 3.01	12.47	0.0001	**S**
Group B	**Brachial**	13.77 ± 3.33	13.19 ± 3.14	12.47 ± 2.73	20.68	0.0001	**S**
	Ankle	13.13 ± 3.41	12.37 ± 2.95	12 ± 2.43	14.69	0.0001	**S**

		MD		% of change		p- value		Sig	
		Brachial	Ankle	Brachial	Ankle	Brachial	Ankle	Brachial	Ankle
Group A	**Pre- mid treatment**	0.94	0.47	6.58 ↓	3.26 ↓	0.001	0.02	**S**	**S**
	Pre- post treatment	1.69	1.11	11.84 ↓	7.7 ↓	0.0001	0.004	**S**	**S**
	Mid- post treatment	0.75	0.64	5.62 ↓	4.59 ↓	0.001	0.01	**S**	**S**
Group B	**Pre- mid treatment**	0.58	0.76	4.21 ↓	5.78 ↓	0.001	0.001	**S**	**S**
	Pre- post treatment	1.3	1.13	9.44 ↓	8.6 ↓	0.001	0.001	**S**	**S**
	Mid- post treatment	0.72	0.37	5.45 ↓	3 ↓	0.003	0.17	**S**	**NS**

$\overline{X}$: Mean **SD: Standard Deviation** **MD: Mean difference**

p value: Probability value **S: Significant**

Table 3 represent the percentage of improvement between pre and post measurements in men and women in each group where women have higher percent than men in both groups.

Table 3. Comparison between men and women mean values of brachial and ankle PWV of group A & B:

Females		**Pre**	**Post**	**MD**	**% of change**
		$\overline{X}$ **±SD**	$\overline{X}$ **±SD**		
Group A	**Brachial PWV (m/s)**	15.05 ± 3.68	12.87 ± 2.96	2.18	14.48
	Ankle PWV (m/s)	15.41± 4.12	13.76 ± 2.99	1.65	10.7
Group B	**Brachial PWV (m/s)**	13.71 ± 3.61	12.06 ± 2.72	1.65	12.03
	Ankle PWV (m/s)	13.43 ± 3.75	12.09 ± 2.55	1.34	9.97
Males		**Pre**	**Post**	**MD**	**% of change**
		$\overline{X}$ **±SD**	$\overline{X}$ **±SD**		
Group A	**Brachial PWV (m/s)**	13.5 ± 2.88	12.29 ± 2.13	1.21	8.96
	Ankle PWV (m/s)	13.42 ± 3.71	12.84 ± 3.12	0.58	4.32
Group B	**Brachial PWV (m/s)**	13.83 ± 3.23	12.89 ± 2.82	0.94	6.79
	Ankle PWV (m/s)	12.84 ± 3.2	11.92 ± 2.43	0.92	7.16

Discussion:

Group (A) showed that there's a decrease in post treatment measures of on baPWVso it can be used as the treatment tool for elderly patients suffering from arterial stiffness. Also, there's Group (B) showed that there's a decrease in measures of baPWV and it can be used as an effective tool to treat arterial stiffness in elderly but results of the group (A versus B) showed no significant different.

Lai et al., [9] found that baPWV was decreased in WBV group rather than the control group not changed also he found in his study that blood pressure and heart rate was not changed in PWV group.

Otsuki et al., [10] give us another explanation for our result for the significant effect of WBV on baPWV in Group (A) when he found the PWV group show significant changes while control did not show any change also, both groups (PWV and control) didn't show any change in the blood pressure and heart rate.

Arturo et al., [11] reported that when tested 15 men included in two groups (WBV and no WBV) exercise there's no reported a significant effect on baPWV and cfPWV in both groups and faPWV showed decreasing in its results in WBV group where this results come against by current study on baPWV.

Also, the current study comes in line with the result of another study by seo et al., [12], that included 100 patients and showed the decrease in baPWV measures after the aerobic exercise.

Also, Ammar et al.[13] stated that aerobic exercise decreases the arterial stiffness by decrease baPWV in a systematic review and meta-analysis of randomized controlled trials for forty-two studies include 1627 participant which this give a good support to current study result.

Collier et al.[14] reported in his study that aerobic exercise decreases PWV in the central and peripheral artery so it decreases arterial stiffness, unlike the resistance training that showed an increase in PWV measures in both central and peripheral artery also the aerobic exercise decreases PWV in arterial stiffness patients.

Ferrier et al.[15] recorded that the Arterial stiffness is resistant to any modification, and did not reduce by an 8-week aerobic exercise training program in elderly patients with ISH and cfPWV was higher in ISH patients than in control subjects there was no difference in peripheral PWV between control and ISH patient groups and this come instead to the current study that measure baPWV and different exercising time.

Watanabe et al.[16] who assessed the effect of combined WBV and aerobic exercise versus aerobic exercise alone on baPWV stated that aerobic training alone has no significant effect on baPWV and arterial stiffness rather than combined WBV and aerobic exercise group and the difference in results with current study may be explained also due to difference in exercising time and small group number and short test period.

Miyakia et al [17] found also in a twelve week study when measure Carotid-femoral pulse wave and brachial-ankle PWV and Body weight in obese women significantly decreased after intervention by WBV 3 times per week for Twelve overweight and obese women also The concentration of plasma pentraxin 3, which has a cardioprotective effect, significantly increased after the program.

Kang et al.,[18] investigated the effects of aerobic exercise on the resting heart rate, physical fitness, and arterial stiffness in women patients with metabolic syndrome. The baPWV was significantly decreased also the metabolic syndrome risk factors (weight, % body fat, waist circumference, systolic and diastolic blood pressure, and HDL-Cholesterol) were significantly improved in the exercise. These results give us clarification for current study results that showed the increased effects of Aerobic exercise on baPWV in females

Conclusion:

In conclusion, results of the current study thebaPWV that was tested in the group (A) decreased when compared the pre and post exercise results and also in the group (B) showed a decrease in the results when compared pre and post exercise results. But when results of the group (A) compared versus to the group (B) results they showed no difference between them and this concluded that both of WBV and Aerobic exercise can be used as a treatment tool to arterial stiffness. We recommend further investigation on effect of different types of exercise on other PWV points like cfPWV and faPWV and also we recommend study the effect of WBV and aerobic against control group, also test a larger number of patients in each group and further investigation on effect on both sex.

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