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Effect of whole body vibration training on core strength of young sedentary females

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Abstract

Overview: Increasing rate of sedentary lifestyles, results in the once strong Core muscles to progressively become more inactive, which negatively impinges weakened lumbar core stability in many individuals. Thus, this study was been conducted to assess and compare the strength of core muscles in sedentary females using Whole Body Vibration Training (WBVT).

Methods: For this study 30 female sedentary participants were selected from Pravara Institute of Medical Sciences, Loni, Assessment was done using Kraus Weber Muscular Strength Test, Waist and Hip Circumference followed by Group A receiving WBVT for 6times a week for 4 weeks, with 5 different positions for 10minutes while group B was the controlled group receiving no intervention. The pre and post results were then interpreted using instat graph pad.

Results: Increase in the core strength with mild reduction in the Waist and Hip circumference in the WBVT group.

Conclusion: Significant improvement in the core strength.

Keywords: whole body vibration training, core muscle strength, sedentary lifestyle, kraus weber muscular strength test, waist hip circumference, physiotherapy

1. Introduction

"Laziness Leads Many People Astray."

-Basque Proverb.

Compared with our ancestors, we are spending increasing amounts of time in environments that not only limit physical activity but require prolonged sitting—at work, at home, and in our cars and communities [1]. Scientists studying the ill effects of this decrease in physical activity have revealed a complex, multifaceted relationship among physical work, energy expenditure, and health. Clinical and basic research has focused on the benefits of incorporating regular bouts of exercise into modern life to adjust to some extent for the loss of the physically active life led by our ancestors. Current public health recommendations propose engaging in at least 150 minutes per week of moderate-to-vigorous activities to prevent and deal with multiple chronic conditions, especially cardiovascular disease, type 2 diabetes, obesity and some cancers [2]. Feasible steps to break up prolonged sitting with short bouts of light activity include walking down the hall to speak with co-workers instead of emailing, extending walking distance during trips to the break room or bathroom, and standing or pacing when on the phone. Therefore, sedentary time have beneficial associations with waist circumference, body mass index, triglyceride levels, and 2-hour glucose levels that are independent of total sedentary time and exercise time [3]. Fitness training programs designed by strength and conditioning coaches and personal trainers commonly include a series of exercises designed to emphasize the core musculature, aerobic capacity, flexibility [4].

Increasing rate of sedentary lifestyles, results in the once strong muscle system - that is responsible for maintaining people's postures and movements, progressively become more inactive, which negatively impinges weakened lumbar core stability in many individuals [5]. The "CORE" has been described as a box by means of the abdominals in the front, back by the paraspinals and gluteals, roof by the diaphragm, and the pelvic floor and hip girdle musculature as the base. Particular consideration has been given to the core because it provides a muscular corset that functions to stabilize the body and spine, with and without limb movement. In other words, the core serves as the centre of the functional kinetic chain. Alternatively, the core has been referred to as the "powerhouse," the foundation or engine of all limb movement. A comprehensive strengthening or enhancing of these core muscles has been implemented as a way to avoid and rehabilitate various lumbar spine and musculoskeletal disorders and as a way to enhance athletic performance [6]. Without well-developed core muscles, the body is no longer able to stabilize itself during activity. Poor core muscle function may lead to excessive stress being placed on the spine, which can result in lower back pain, lower back and lower extremity injuries [7].

WBV training is not only a mode of exercise that has recently received awareness as both a medium for improving speed-strength performance in athletes, but also as a complementary training modality to active exercise programs in most bio-kinetics practices, health and fitness centres [5]. Previous studies reveal that low-amplitude, low-frequency mechanical stimulation of the human body is a harmless and helpful to improve muscle strength. Low- frequency vibration has been also applied locally by means of vibrating cables and vibrating dumbbells. The frequencies used for exercise range

from 15 to 44 Hz and displacements range from 3 to 10 mm. The acceleration value varies from 3.5 to 15 *g* (where *g* is the Earth's gravitational field or 9.81 m-s~^{2}). The duration of the WBV sessions varied between 20 and 30 minutes.Thus, vibration provides a perturbation of the gravitational field during the time-course of the intervention [8].

M. Roelants C; Delecluse; *et al.* in 2005 had a study on effect of 24 weeks "whole body vibration" training and fitness training on body composition and on muscle strength.48 untrained females (21.3 ± 2.0 yr) participated. The results recorded a significant strength gain in the whole body vibration group. The conclusion showed 24 weeks whole body vibration training did not reduce weight, total body fat or subcutaneous fat in previously untrained females. Nevertheless, whole body vibration training induces an increase in knee-extensor strength along with a small increase in fat free mass. The gain in strength is comparable to the strength increase following a standard Fitness training program consisting of cardiovascular and resistance training [9]. Dallas, G; Kirialanis, P; Mellos V; *et al.* in 2014 examined the acute effect of a single session of whole body vibration (WBV) on strength and flexibility of lower limbs in young gymnasts. Thirty-two young competitive gymnasts volunteered to participate, and were distributed to either the vibration group or body weight training according to the vibration protocol. It was discussed that the use of whole body vibration as a warm-up method may be incorporated during the training of young gymnasts.

This study concluded that WBV training improves flexibility and explosive strength of lower limbs in young trained gymnasts and preserves the initial level of performance for at least 10-15 minutes after the WBV intervention programme [10].

1.2 Statement of Problem

The people living sedentary lifestyle ignore core strengthening and face various health problems. Implementing Whole Body Vibration Training, a passive and time effective technique, if integrated in the daily routine for 10minutes will motivate the sedentary population to take initiative towards healthy living. Since, very few literatures have been found where Whole Body Vibration machine has been used for strengthening the core. Thus, this study is being conducted to assess and compare the strength of core muscles in inactive females using Whole Body Vibration Training.

1.3 Hypothesis

Null Hypothesis (H0)

There will be no significant improvement in the strength of core muscles in 30 participants with sedentary lifestyle when trained with and without WBVT in terms of Kraus Weber muscular strength test.

Alternative Hypothesis (H1)

There will be significant improvement in the strength of core muscles in 30 participants with sedentary lifestyle when trained with and without WBVT in terms of Kraus Weber muscular strength test.

1.4 Limitations

- Only Females were recruited in the study.
- Age Group from 18 to 25years.
- Normal sedentary individuals were included, not the patients.
- Only one geographical area was covered.
- The study conducted was of short duration.

2. Materials and Method

The Prospective and Comparative Study included 30 Female sedentary participants (18- 25years) from Pravara Institute of Medical Sciences, Loni. Subjects with any cardio-respiratory diseases, neuromuscular disease, history of fracture in past 6 months, vertebro-basilar insufficiency, balance impairment, severe migraine, recent infections and wounds, slipped disc, discopathy, spondylitis, diabetes were excluded. The participants were briefed about the nature of study, the duration of intervention and the intervention used was in the language best understood by the participants. They were requested to simplify their queries regarding the study, if any. An informed written consent form was then obtained from the participants. The exercise program was designed on Fitking Whole Body Vibration Machine of Fitness centre of Girls hostel for 6 times a week for 4 weeks with 5 positions(Standing, Standing with shoulder abduction and trunk rotations, Standing with trunk forward flexion, Sitting with knees flexed and V-sitting). Each session lasted for 10 minutes and the participants were instructed to contract the abdominals and gluteals for every 5seconds followed by relaxation for 5 seconds continued for 2minutes for each position without holding the breath. The speed of vibration was maintained between 1-50 m/s. The machine named Crazy Fit Massage by Fitking used for the study had an input of 220 -240V, frequency ranged from 50 to 60 Hz, power consumption of 200 to 300W; speed ranged between 1-50m/s and its amplitude was 0-10mm.

Position used for the WBVT

Fig 1: Standing

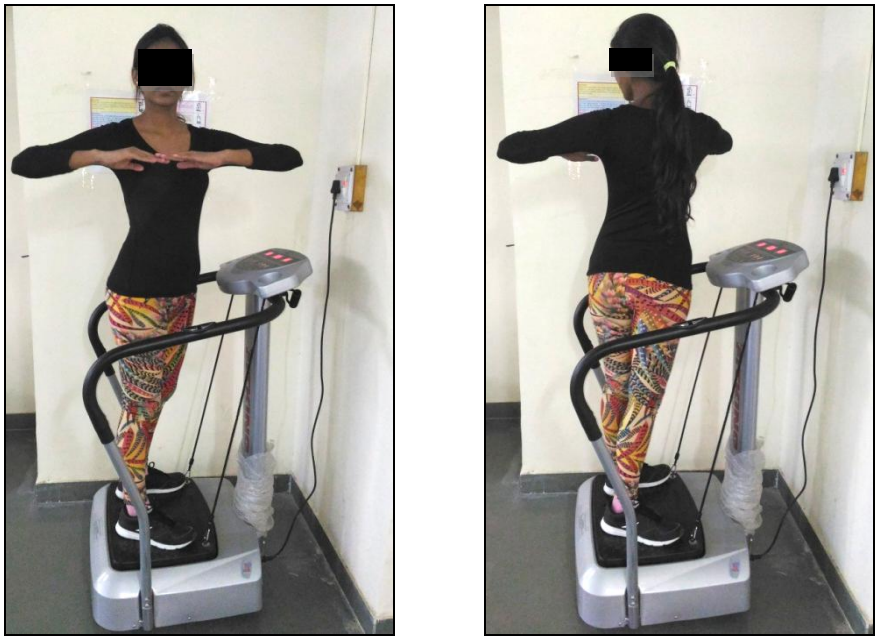

Fig 2: Standing With Shoulder Abduction and Trunk Rotations

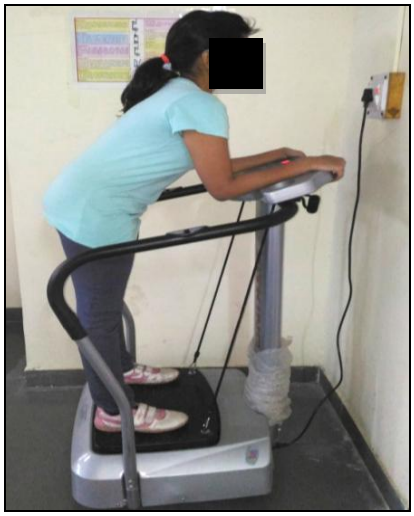

Fig 3: Standing With Trunk Forward Flexion

Fig 4: Sitting with Knees Flexed

Fig 5: V-sitting and its Progression

3. Data analysis and Interpretation

Table 1: Demographic Representation of the Strength of Abdominal and Psoas muscle. (Step 1)

	PRE (in %)	POST (in %)
Group A	93.33	100
Group B	86.66	85.33

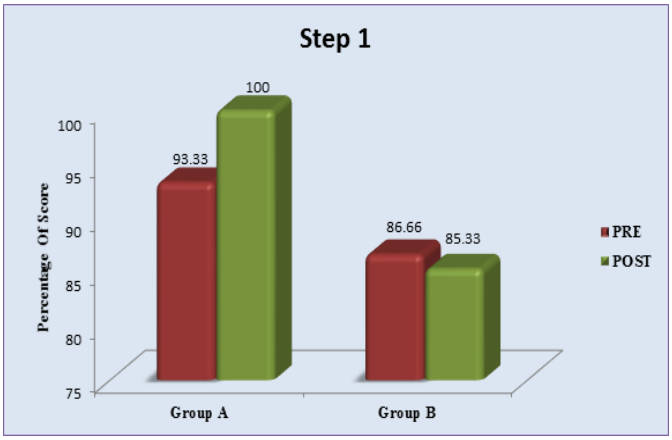

Fig 6: Represents the Strength of Abdominal and Psoas muscle. (Step 1)

Result No. 1

The above study shows that the post strength of abdominals and psoas muscles of Group A has been increased to 100 % which was 93.33% before the whole body vibration training. Whereas, the strength of Group B has reduced to 85.33% from 86.66%.

Table 2: Demographic Representation of the Strength of Abdominal muscles only. (Step 2)

	PRE (in %)	POST (in %)
Group A	91.33	100
Group B	92	90

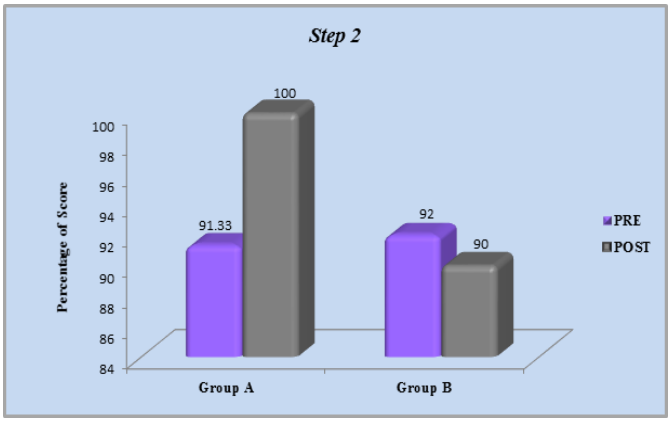

Fig 7: Represents the Strength of Abdominal muscles only. (Step 2)

Result No. 2

The above study shows that the strength of abdominal muscles has been increased drastically from 91.33% to 100% of the participants of Group A. But, on the other hand, the strength has reduced by 2% from 92% to 90% in Group B participants.

Table 3: Demographic Representation of the Strength of Lower Abdominal muscles. (Step 3)

	PRE (in %)	POST (in %)
Group A	67.33	87.33
Group B	64	42

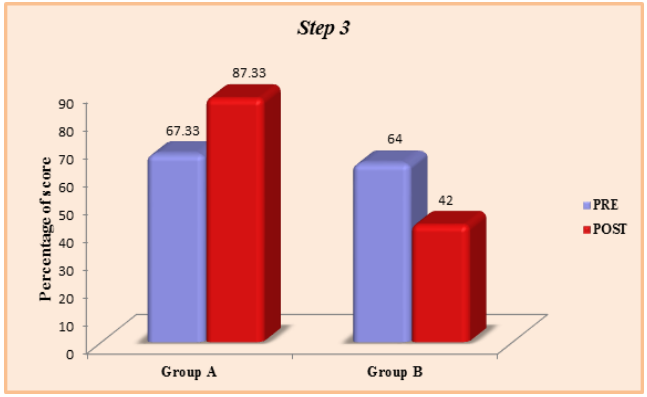

Fig 8: Represents the Strength of Lower Abdominal muscles. (Step 3)

Result No. 3

On comparison, the above graphs show that the strength of Lower abdominal muscles of Group A participants has increased from 67.33% to 87.33% whereas, there is a decline from 64% to 42 % in the strength of Group B participants.

Table 4: Demographic Representation of the Strength of Upper Back Muscles. (Step 4)

	PRE (in %)	POST (in %)
Group A	84.66	100
Group B	85.3	67.33

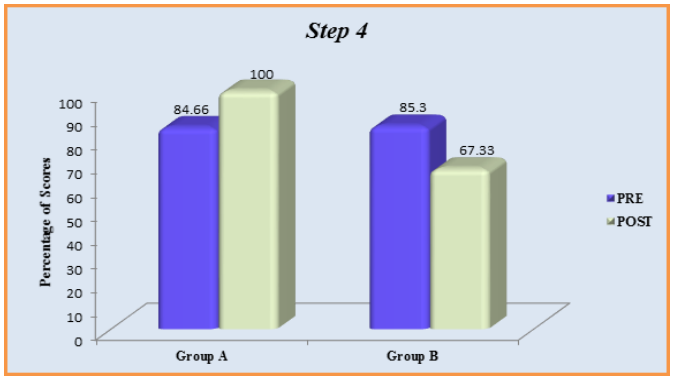

Fig 9: Represents the Strength of Upper Back Muscles. (Step 4)

Result No. 4

The above study shows that there is an increase in the strength of Upper back muscles of Group A participants from 84.66% to 100% while there is decrease in strength of Group B participants from 85.3% to 67.33%.

Table 5: Demographic Representation of the Strength of Lower Back Muscles. (Step 5)

	PRE (in %)	POST (in %)
Group A	40	100
Group B	36	53.33

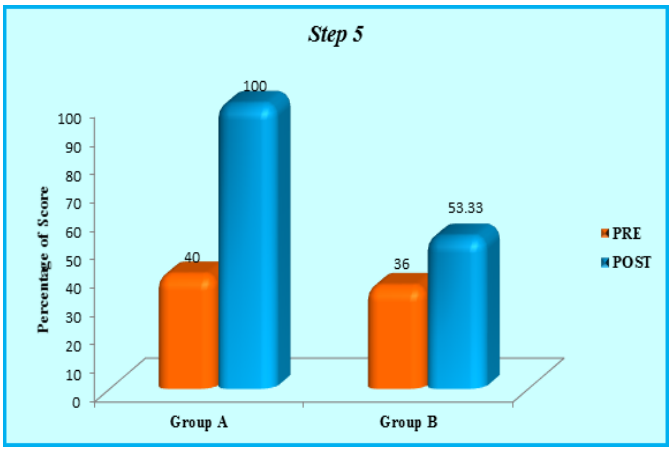

Fig 10: Represents the Strength of Lower Back Muscles. (Step 5)

Result No. 5

On comparing the above graphs, there is a drastic succession from 40% to 100% in the strength of Lower back muscles of Group A participants while there is mild increase in the strength of Group B participants from 36% to 53.33%.

Table 6: Demographic Representation of the Back and Hamstring Muscle Flexibility. (Step 6)

	PRE (in %)	POST (in %)
Group A	60	71.33
Group B	40	40

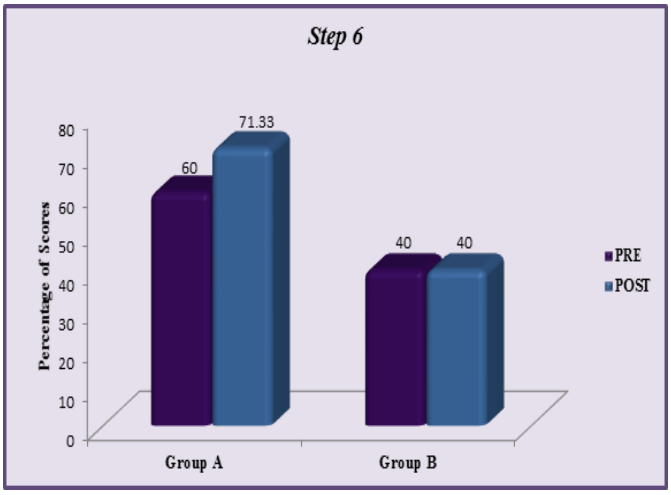

Fig 11: Represents the Back and Hamstring Muscle Flexibility. (Step 6)

Result No. 6

On comparison, the above study shows that the flexibility of Back and Hamstring muscles of Group B participants is 40% which is unchanged. Whereas, the flexibility of Group A participants has been increased to 71.33% which was 60% before the WBVT.

Table 7: Demographic Representation of the Mean of Waist Circumference

	PRE	POST	't' value	'p value'	Inference
Group A	83.6	82.6	0.8510	< 0.0001	Extremely significant
Group B	85.4	85.4	0.05684	< 0.0001	Extremely significant

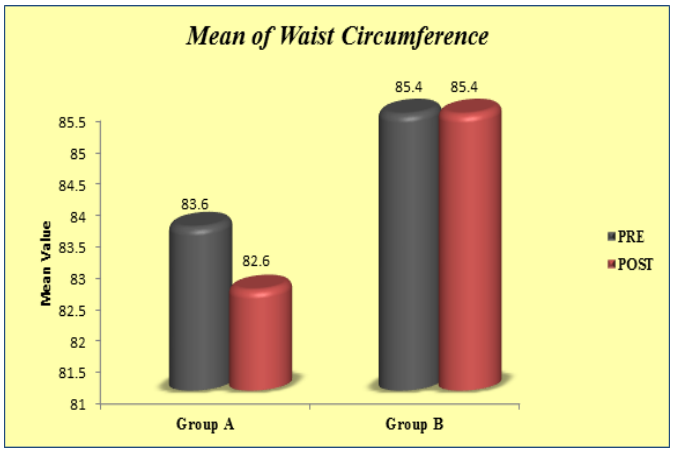

Fig 12: Represents the Mean of Waist Circumference

Result No. 7

The above study shows that, the mean Waist circumference of Group B remains unchanged with 85.4 while the mean value of Group A has been reduced slightly from 83.6 to 82.6. On comparing pre and post intervention measures of Group A the't' value was 0.8510 and on comparing pre and post intervention measures of Group B the't' value was 0.05684. The 'p' value of both the group is < 0.0001 which is considered extremely significant.

Table 8: Demographic Representation of the Mean of Hip Circumference.

	PRE	POST	't' value	'p value'	Inference
Group A	100	98.66	2.751	< 0.0001	Extremely significant
Group B	100.46	101.13	0.7255	< 0.0001	Extremely significant

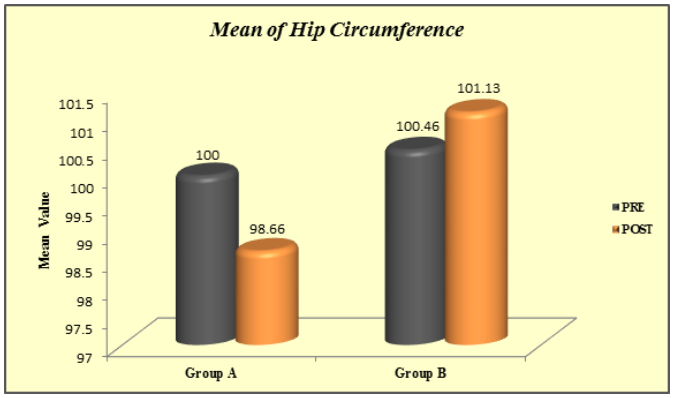

Fig 13: Represents the Mean of Hip Circumference

Result No. 8

The above study shows that, the mean Hip circumference of Group A remains reduced from 100 to 98.66 while the mean value of Group B has been increased slightly from 100.46 to 101.13. On comparing pre and post intervention measures of Group A the't' value is 2.751 and on comparing pre and post intervention measures of Group B the't' value is 0.7255. The 'p' value of both the group is < 0.0001 which is considered extremely significant.

4. Discussion

It's not how Long, It's how Strong.

-*Jackie Warner.*

This is the first randomized controlled trial, to our knowledge, comparing the core strength with different postures during Whole Body Vibration (WBV) exposure and without WBV exposure in young females. The five positions given during the Whole Body Vibration Training(WBVT) were Standing, Standing with shoulder abduction and trunk rotations, Standing with trunk forward flexion, Sitting with knees flexed, and V-sitting. As per the instructions the participants had to contract the abdominals and gluteals for every 5secs and relax continued for 2minutes for each position without holding the breath.

In standing, with the basic stance helps to warm up the body and prepare muscles for more demanding movements. This exercise targets the buttocks, legs and the core area, being great for strengthening the muscles that keep body stable and helps maintain a proper posture. The second position, standing with shoulder abduction and trunk rotations helps the oblique muscles to twist the body at the waist and straighten when bent to the side. During WBVT, the rotation to one side leads to the stretch of the other and vice versa. Whereas, the third position, Standing with trunk forward flexion includes flexion of the trunk at pelvis, maintaining the trunk in a straight alignment. This enhances the vibrations over the erector spinae. This helps to improve the extension range and also maintains correct curvature of the spine. In the fourth position which is sitting with knees flexed, enhances the vibrations over the gluteals and the abdominals and extensor muscles. These vibrations loosen the muscles around the waist (core) and tone often unused core muscles by causing them to contract and relax several times per second. The last position V-sitting is an effective abdominal and core exercise that works the rectus abdominals, the external obliques, and the internal obliques. It also engages the hip flexors and builds core strength by working multiple core areas at same time.

Further, the study results show an improvement in all examined strength variables in post-vibration treatment in the WBVT group (100%, 100%, 87.33%, 100%, 100%, 71.33%), whereas the corresponding percentage changes in the NWBVT group were (85.33%, 90%, 42%, 67.33%, 53.33%, 40%) respectively. The study results of post mean interventional waist and hip circumference of WBVT group is 82.6 and 98.66 respectively while that of NWBVT group is 85.46 and 101.13 respectively. Thus, the short duration and the light intensity of the intervention program applied in the study also produced a greater percentage improvement in back and hamstring muscles flexibility compared to the traditional stretching program used by gymnasts.

5. Conclusion

Results from the current study appear to suggest that a 4-week WBV training programme, conducted six-times-a-week, concludes to have the potential to significantly improve the core strength in young sedentary females. Thus, the results from existing and previous studies would lend support to the inclusion of whole body vibration interventions for a range of health, fitness, and performance improvements.

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