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# A COMPARATIVE STUDY OF RESISTANCE TRAINING VERSUS WEIGHT BEARING EXERCISES ON BONE MASS DENSITY, MUSCLE STRENGTH AND QUALITY OF LIFE IN POST-MENOPAUSAL WOMEN

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**ABSTRACT:**

**Background:**

Osteoporosis is prevalent in Indian post-menopausal women and contribute to decreased BMD, muscle strength and Quality of Life (QOL). Osteoporosis is the most common cause of stress fractures, low bone strength and becomes a cause of frequent visits to the physiotherapy OPD's among post-menopausal women. The study compared the effect of resistance training versus weight bearing exercise on Bone Mineral Density (BMD), muscle strength and QOL in post-menopausal women. Purpose of the study was to calculate T score (BMD), muscle strength and BREF score and to compare whether these outcome measures changes with 12 weeks of exercise intervention through Weight bearing (WB) and Resistance Training (RT) exercises

**Study Design:**

Non - Randomized experimental study.

**Method:**

Assessment of BMD was done on post-menopausal women ( ≥5 years of menopause) and women having T score between -1 to -4 were included in the study.

WHO-QOL BREF score and muscle strength was analysed. Participants were divided in 3 groups by lottery method. 1 group received weight bearing exercises. Second group continued with resistance training exercises and the last group was control group which was asked to maintain daily physical activity. Pre and post exercise intervention, data was recorded. Paired , unpaired T test and annova was used to analyse the data.

**Result:**

The WB group expressed better BMD score, whereas; muscle strength was improved in RT group. QOL physical domain showed better improvement in RT group as compared to WB group; whereas, psychological, social and environmental domains were improved in WB group.

**Conclusion:**

The result of the study indicates WB exercises are good to improve BMD at calcaneal site but WHOQOL-BREF indicated better score for psychological, social and environmental domain. The post-menopausal women, who took part in RT group showed significant strength improvement and statistically significant improvement in physical domain of quality of life. Further many evidences to date suggest that physical activity is associated with good HRQOL measured by WHOQOL-BREF.

The larger randomized control studies are needed to further evaluate the effect of WB exercises at various sites of peripheral ultrasonic bone densitometry like wrist and calcaneum. Definitely physical activity in any form would enhance physical domain in post menopausal women.

**Keywords:** weight bearing exercises, Resistance Training exercises, WHOQOL-BREF, Bone mineral Density

## INTRODUCTION:

Osteoporosis is rising in India. The prevalence is high and thought to occur early in Indian women[1]. Many studies suggest that Indian women have lower bone density than western counter parts, therefore osteoporotic fractures occur 15 years earlier in Indians[2].

BMD measurements are frequently used in clinical practice to assess fracture risk. The risk of fracture increases with low BMD. Osteoporosis is defined as skeletal ldisorder characterized by low bone strength leading to an increased risk fragility fracture. The maximum bone loss occurs in women during peri-menopause since it is associated with oestrogen insufficiency, a condition of menopause[3]. Osteoporosis has numerous medical implication and huge economic impact. Unfortunately, it is undiagnosed until a fracture occurs, therefore BMD screening should be done on regular basis. So, the prevention and modification to decrease osteoporosis and related fractures can be done. The gold standard for measuring osteoporosis is BMD by the dual energy X-Ray absorptiometry densitometer (DXA) [4]. The activities which will restrict the loss or improve the bone mass should be encouraged by prescribing exercise prescription on regular basis. Impact exercises are recognised, beneficial for stimulation of bone tissue.

The level of physical activity and QOL in post menopausal group decline due to post menopausal changes and social responsibilities. There is a strong evidence that upliftment of physical activity and exercise training contributes to an increase in bone mass, physical activity and QOL[26,27,28] WHOQOL-BREF is more relevant to evaluate changes in QOL of older women than SF36 as said by Paula Costa Castro, Patrícia Driusso, and Jorge Oishi in their study[78]. It covers 4 domains of QOL (physical, psychological, social, environmental). Rather than focusing on impairments, WHOQOL-BREF gives priority response to aging process. BREF is reliable, measured broad range of factors and focuses on individual opinions about QOL[78]

Other variables such as muscle strength, type of muscle contraction, duration and the intensity of exercise are also determinants to induce changes in bone metabolism of post-menopausal women[5, 6], Hand held dynamometer is accurate and effective measure of muscle strength. It is the most objective and consistent tools for muscle testing. Research has shown that hand held dynamometers are more superior and provide reliable results. The results are trustworthy when tested by one practioner or varied proffesionals[77].

Therefore the purpose of the study is to engage post-menopausal women for weight bearing activities and resistance training to observe their BMD, muscle strength and QOL score before and after doing prescribed exercises.

BMD in post menopausal women, resistance trained versus weight bearing trained is a novel approach. Both trained post menopausal women were compared with untrained controls. It was hypothesized that BMD score would be better in weight bearing post menopausal group

## AIM:

"To know effect of resistance training versus weight bearing exercises on bone mass density, muscle strength and quality of life in post menopausal women."

## OBJECTIVES:

At the end of 12 weeks exercise programme in post menopausal women :

**Primary** : To observe
1. The effect of resistance training
2. The effect of weight bearing exercise

} On BMD, muscle strength and QOL

**Secondary** :
To compare the effect of resistance training versus weight bearing exercises in terms of BMD, muscle strength and QOL

## MATERIALS AND METHODOLOGY:

The study was designed to compare the effect of resistance training versus weight bearing exercises on bone mass density, muscle strength and quality of life in post menopausal women. Pre-requisite permissions were taken from the head of the institution and institutional ethical committee before commencement of the research work.

### Research design:

The study design was a Non Randomized experimental study (Pre & Post design). Experimental study is a type of prospective study in which some intervention is involved such as deliberate application or withdrawal of suspected cause or changing one variable in the causative chain in the experimental group while no change in the control group and observing and comparing the outcome. The techniques of randomization help us to reduce bias in an experimental study. In other words, the principle of randomization indicates that we should design or plan the study/experiment in such a way that the variations caused by extraneous factors can all be combined under the general heading of "chance". The principle of randomization is achieved through selecting the sample units of a study/experiment randomly.
In this study, 12 weeks of WB exercises were given to first group, RT exercises were given to the second group. The third group was the control group in which no intervention was done. All the three groups were compared for BMD, quality of life and muscle strength.

### Sampling procedure:

Simple Random Sampling with lottery method was used for sampling of data. All women with ≥ 5 years of menopause, whose BMD score was ≤ -4 were included in the study. Subjects were selected from Out patient department, community health centres and women's health clinic.

**Duration of Study**: 12 months

### Sample size:

50 per group totalling to 150 (open epi.info)[22]
Sample size estimation: Sample size was drawn from original article published in International Health Care & Biomedical Research Journal Vol 2 issue 3 April 2014[13].
Taking alpha error =5% & 1- beta =80%

### Target population:

Women with ≥ 5 years of menopause, having BMD score between -1 to -4 were included in the study.

**Method of selection of study subjects (Eligibility Criteria):** the subjects were selected based on the following criteria:

a) Inclusion criteria:
1. >5 years from the onset of menopause
2.BMD T score between -1 to -4.
3. Willing to participate.
4. Pre-screening by Clinician

b) Exclusion criteria:

1.Females on HRT
2.BMD < -4
3. BMI < 18kg/$m^2$
4. Drug induced

**Method of selection of comparison/control group:** Patients were selected from the physiotherapy OPD with referral from both Gynecology and Orthopedic Department by Simple random technique. The 3 groups are:

1. Weight bearing exercise group (WB)
2. Resistance training exercise group (RT)
3. Control Group (CG), although they had BMI T score between -1 to -4, they were asked to maintain their routine level of physical activity or prescribed by physician.

**OUTCOME MEASURES:**

1. Pre and post BMD (12 weeks) Bilateral radius and calcaneous

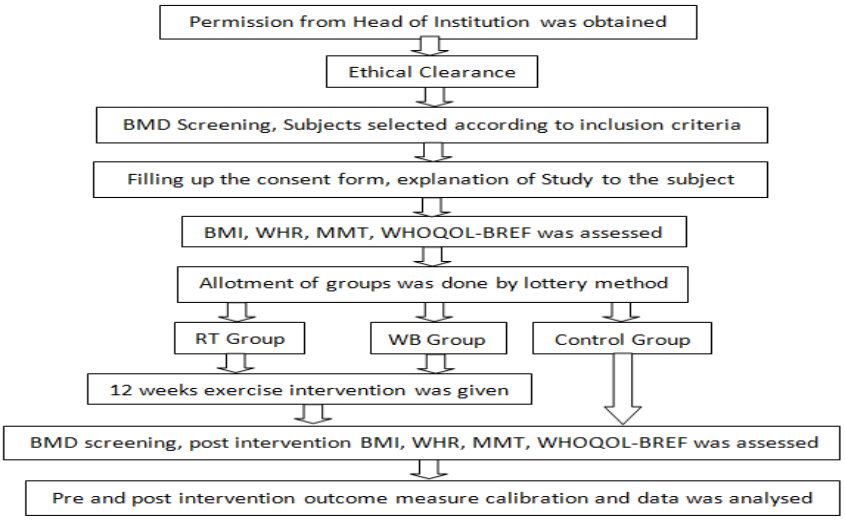
Caliberation of BMD on day 1 and at end of $12^{th}$ week by peripheral ultrasonic bone densitometry

2. Strength testing by dyanamometer bilaterally(muscle strength)

- quadriceps
- hip flexors
- Plantar flexors
- Dorsi flexors
-biceps
-triceps
-wrist flexors
-wrist extensors

**3. WHOQOL-BREF**

**PROCEDURE:**




**EXERCISE PRESCRIPTION [14,16,17,18] :**

**Duration of exercise :** 35 minutes- 10minutes: warm up phase
-15 minutes: aerobic exercise
-10 minutes: cool down phase

**Warm up phase:** 1. Auto stretching (static and dynamic) of long muscles
2. Free movements of extremity
3. Stationary Bicycle

**Aerobic Phase:**

**Resistance Training (RT)Group:**
-Monday and Thursday off
-exercises were done in pain free range

**Weight Bearing (WB) Group:**
- Sunday and Wednesday

**EXERCISES: (1RM)**
1.strengthening of quadriceps
2.Calf Strengthening
3.Hip Flexor strengthening
4.Hip extensor strengthening
5.Biceps curls
6. Triceps curls
7. Wrist extensors strengthening
8. Wrist flexors strengthening

**EXERCISES:**
1. Walking and brisk walking
2. Lunges
3. Sit to stand from chair
4. Toe Standing & heel standing (5 Holds with 10 reps)
5. Prone triceps extension
6. Wall squats and wall press
7.Stair Climbing
8.Kneel walking on firm surface
9. Spot jogging

Cool Down Phase: 1. Cat and camel exercises
2. Long sitting exercises
3.Pressing knee against floor
Control group was asked to maintain their regular physical activity.

## DATA ANALYSIS

The raw data collected was spread on Microsoft excel sheet 2010 (annexure ) and analysed to compare the effect of resistance training versus weight bearing exercises on bone mass density, muscle strength and quality of life in post menopausal women.
The statistical analysis was carried out by STATA version 10.1 (2011)
VARIABLES:

| Independent | Dependent |
|---|---|
| 1. BMI | 1. BMD |
| 2. Age | 2. Strength of the muscle |
| 3.WHOQOL-BREF | |

The data obtained helped to understand changes in BMD, muscle strength, QOL after 12 weeks of exercise intervention between groups and testing of hypothesis was undertaken.
STATISTICAL TESTS : PAIRED & UNPAIRED t test multiple group comparison was done by Annova (F test)
Bonferroni multiple comparison test for pair wise comparison of mean.
Level of significance was fixed at $p < 0.05$

## RESULTS

The WB group expressed better BMD score, whereas; muscle strength was improved in RT group. QOL physical domain showed better improvement in RT group as compared to WB group; whereas, psychological, social and environmental domains were improved in WB group.

## DISCUSSION

Bone loss is considered a universal feature of aging and it is associated with increased fracture risk specially in older women. However, bone loss may not be an inevitable consequence of aging, indeed the women who engage in heavy physical activity on daily basis, no age related decrease in BMD has been detected.
Current study is done in agreement with Nelson ME et al, in post menopausal women aged 50.70 years. High intensity strength training for 3 months to 1 year prevented the significant bone loss or remained unchanged that occurred in the CG. Furthermore, considering that exercise has established

pleiotropic favourable effects on health, besides those on bones, even small improvements in bone characteristics in elderly women should be considered of clinical import[60].

Li WC, Chen YC, Yang RS, et al conducted a meta analysis evaluating randomized trials of high quality that involved a total of 256 osteopenic and osteoporotic participants revealed that interventions with combined exercise programs improved physical function and BMD score more in exercise groups than in controls. Present study falls in similar principles and protocols of Li WC, Chen YC, Yang RS, et al[61].

None the less Rizzoli et al in a recent review of the evidence based strategy for the management of low BMD in elderly listed exercise training in the first line of treatment then vitamin D and calcium supplementation followed by that use of evidence based anti- osteoporotic drugs[62].

The present study is falling on the similar lines of Tolomio S, et al and Pfeifer M, reported that subjects with low BMD would benefit a great deal from specific exercise programmes[23,32,63]. This can be explained by the fact that muscular strength is the main output of exercise enhancing BMD[64,65,66]. It is a predictor of BMD in elderly subjects[67], because the force exerted by muscle to pull bones while muscular contraction has a strong osteogenic stimulus[68]. In support of this idea it was postulated that the resistance training program would increase the BMD in terms of improved T score but in the current study the WB exercise group showed better improvement in BMD in contrast to the above study. This may be because of the maximum stress exerted on the major weight bearing bones. The architectural properties of bones would have been major contributory factor to this.

The significant positive changes of T score in WB exercise group than RT group indicated that WB had more influence on BMD specially on WB bones. The mechanical loads of WB activities are transmitted to the skeleton by muscle pull and gravitational forces where the bone cells selectively responds to different mechanical stresses to increase BMD[69].

It also explains that WB activities have more osteogenic effect on bone than RT activities[70]. In the current study, brisk walking, walking, squatting, lunges have been useful in increasing bone strength mass in post menopausal women especially at WB sites. It is also reported that the effect of training programme on bone is sight specific[32,71] and load dependent[31,64]. Any type of exercise training usually benefits intrinsic and extrinsic bone mechanical properties[31] .

The result of the present study suggests that health related QOL measured by WHO-QOL BREF significantly improved after WB exercises and RT exercises as compared to controls.

The improvements of WHO-QOL BREF seen in the current study are supported by same previous studies which found that strengthening exercises may prevent loss of physical independence and thereby improved QOL in post menopausal women. Well designed WB supervised exercise program may have psychological advantage such as elevation of cognitive function, balance and sense of well being.

As per WHO criteria and inclusion criteria of study, all 150 subjects had osteoporosis. The percentage of women with T score less than -2.5 was considerably more in $6^{th}$ decade onwards. 56 women had scored less than -2.5 SD. In the current study the fall in T- score was observed for $5^{th}$ to $6^{th}$ decade. As such the economical strata was not considered for the statistical analysis but it was noticed that osteopenia and osteoporosis is the concern for all economic strata.

Mean age of this study group was 64.10±10.27 with the age ranging from 43 to 90 years. Literature suggests that increasing time since menopause was a risk factor for osteoporosis and similar statement was made by Finkelstein et al on 3302 women, where, it was found that BMD loss accelerates substantial in the late peri menopausal and first few years of post menopausal age. In this study, he found the BMD loss from the spine was highest. This has been correlated by several other authors followed by that the calcaneal loss was observed[1]. In this study, the negative relationship was established between menopausal age and T score. The inference could be drawn from in two terms: the first inference suggests that late menopause will show better T score at late age but the early menopause and advancing age will have strong negative relationship with T score, means poor T score for early menopausal women at early stages of post menopausal life.

In the present study, all the participants were supplemented with calcium intake in the diet or medicated form.

From the graph 21 it was observed that the improvement in the BMD of subjects who had undergone weight bearing exercises indicated significant mean difference in terms of improvement in T score of post menopausal women. The striking point of study was the T score and menopausal age revealed strong negative co-relation. (graph 22) The calculated r value for the T score and menopausal age(r) was 0.001. As the post menopausal age was increasing the T score was reducing.

The current study finding suggest that regular physical activity in terms of WB exercises at moderate level can help to improve bone density in post menopausal women. This finding echos those of similar studies that have shown the benefits of WB exercises on BMD by Biplob Chawdhury and Bolton et al[13,72]. The mean difference in BMD in current study closely approximates that of the Bolton's study[72]. These findings can be correlated to the impact of RT or WB largely to the effect of loading on skeleton. Statistically significant bone improvement has not significantly showed the improvement for physical domain of WB group.

The physical domain showed improvement for RT group. This could be attributed to the fact that muscle strength is basic requirement for physical activity and its physical performance.

Most of the studies suggest that muscle strength is an independent predictor of good physical strength performance & BMD at all three sites(calcaneum, radius, and vertebra L3,L4,L5). The integrated physical load on the skeleton may be a final common pathway for both the training groups.

A study by Nikander & Cols says that athletes participating in aerobic non weight bearing sports, showed lower BMD as compared to the ones taking part in impact sports. The aerobic non weight bearing sports generate muscle force of high velocity with no impact forces. Therefore it implies that gravitational loading is relevant to bone stimulation[6,73].

A RT programme of moderate to high intensity( 70%- 90% of 1 RM)including 3-4 bouts of 8-12 repetitions of each exercise, performed 2 or 3 times a week, improves BMD of hip & femur in post menopausal women when performed over 1 year[74]. During RT, variety of muscle forces are applied to bone which generate stimuli capable of promoting a bone osteogenic response[75].

A systematic review on effects of resistance training exercise on function in older adults with osteoporosis revealed that intervention using RT have a positive effect on physical function domain and ADL[76].

Bus et al studied 42 post menopausal women allocated to 3 groups- strengthening, impact exercises and no exercise. After 6 months there was significant improvement in BMD for impact exercise group. These results show that impact forces are a relevant element in the stimulation of bone metabolism.

Hence hypothesis of the study was accepted that weight bearing exercises shows better improvement in BMD, muscle strength and QOL.

The study was taken up to find out the effect of RT versus WB exercises on BMD, strength of muscle & QOL by WHOQOL-BREF. This aim was proven by the hypothesis of the current study stated that WB exercises showed better improvement in T score thereby improved the health of bone among post menopausal women.

The WB exercise group result was very much encouraging in terms of statistical analysis done for the bone density score (BMD). The T value were significantly improved (p value- 0.000), whereas muscle strength showed improved score although it was statistically non significant . Even QOL was improved pre and post exercise session for WB group in terms of WHOQOL-BREF since BREF is ICF friendly scale. It proved to be easy to mark by the subjects. It can be one of the important outcome measure tool to decide the efficacy of exercise programme.

The another experimental group that was RT group which was subjected to mechanical muscle strengthening by tying up the weight cuffs to respective muscle proved to be one of the important exercise protocol to improve the strength of muscle. The RT group muscle strength was revealed improved. T score was not statistically significant whereas strength improvement was highly significant for the group.

Pre and post WHOQOL-BREF comparison for the WB group was statistically significant ( p value- 0.001). When both the group comparison was done for BMD the significant result was found for WB group (p value- 0.001).
Muscle strength was significantly improved for RT group. The QOL by WHO BREF was compared for both the groups. The final score on BREF was better for RT group in physical domain when compared to WB group and better for WB group in psychological, social and environmental domain when compared to RT group.
Therefore it is stated that there is definite change in BMD and muscle strength after WB exercises as well as RT exercises in post menopausal women.

## LIMITATION

- The limitation of the study was that the measurements were performed only before and after treatment without any in between and further follow up.
- Calcium intake and BMD score association was not addressed in this study. Calcium intake and BMD score association could be the spurt of interest for further research.
- In the current study, age wise BMD was not analysed for all the three groups. The analysis of BMD score with age and combination of exercise will be the interest area of research.

## CLINICAL IMPLICATION- SUGGESTION

The clinical implication of this study is to involve osteoporotic post menopausal women in regular exercise training programs whether it is tailor made or group therapy to lead a good HRQOL and to reduce risk of fall and its consequences.

## TABLES AND GRAPHS:

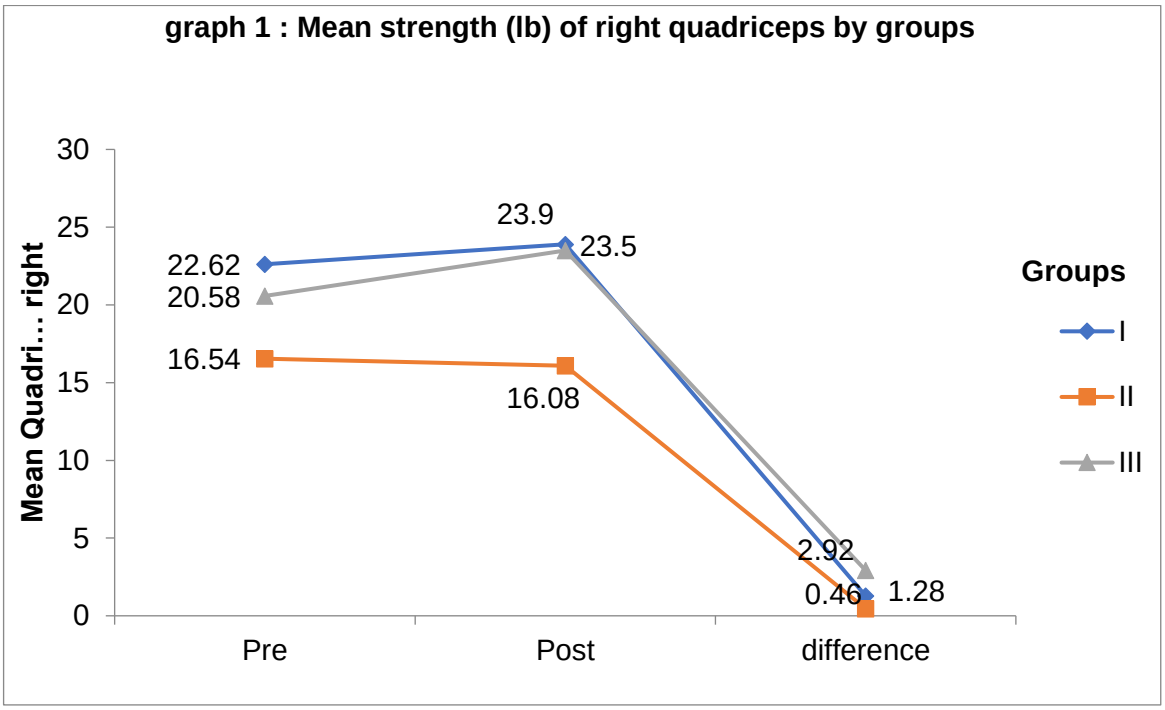
In graphs;
Group I– weight bearing group,
Group II- Control group
Group III- resistance training group

**Table 1:** Mean Age of groups and menopause (years)
n=150; 50 in each group

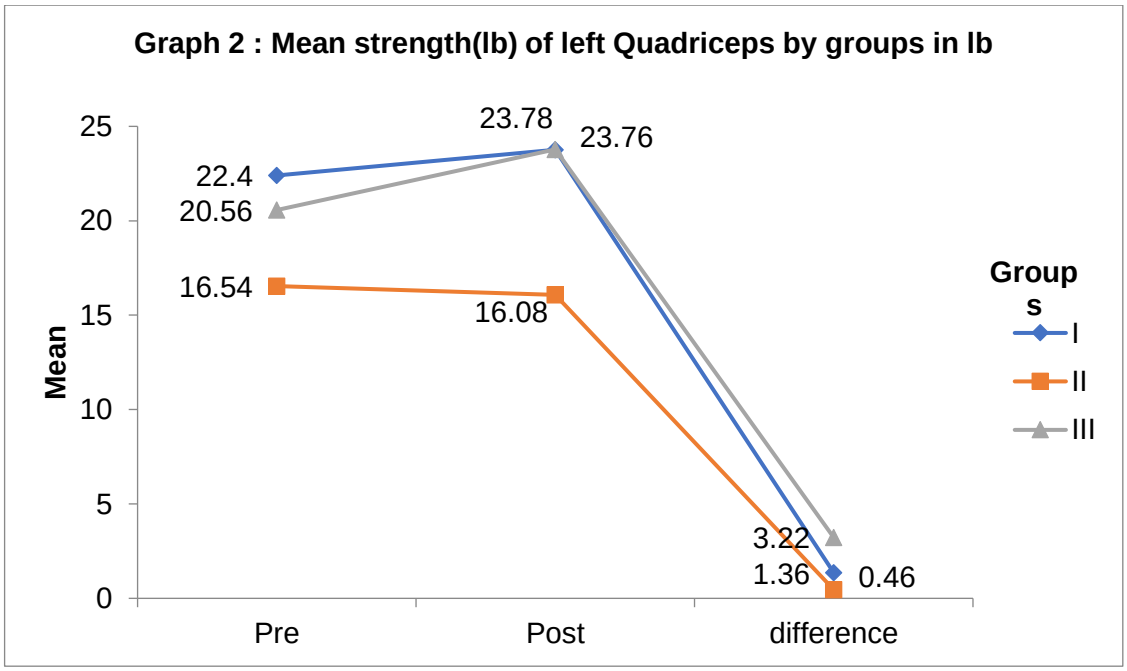
| Groups | Mean Age ± SD | Mean age of menopause ± SD |
|---|---|---|
| Weight bearing group | 58.64 ±5.1 | 44.66 ± 3.98 |
| Resistance training group | 57.82 ±6.94 | 44.66 ±3.78 |
| Control group | 68.56 ±9.27 | 43.14 ±5.16 |
| P value | 0.0000 | 0.1350 |

**Table 2 :** pair- wise comparison of mean difference of quadriceps strength
n= 150; 50 in each group

| In lb | | RIGHT Pre | P- value | RIGHT Post | p- value | LEFT Pre | p-value | LEFT Post | p-value |
|---|---|---|---|---|---|---|---|---|---|
| WB vs CG | | 6.08 | 0.000 | 7.82 | 0.000 | 5.86 | 0.000 | 7.68 | 0.00 |
| WB vs RT | | 2.04 | 0.026 | 0.4 | 1.000 | 1.84 | 0.066 | 0.02 | 1.00 |
| CG vs RT | | 4.04 | 0.000 | 7.42 | 0 | 4.02 | 0.00 | 7.7 | 0 |



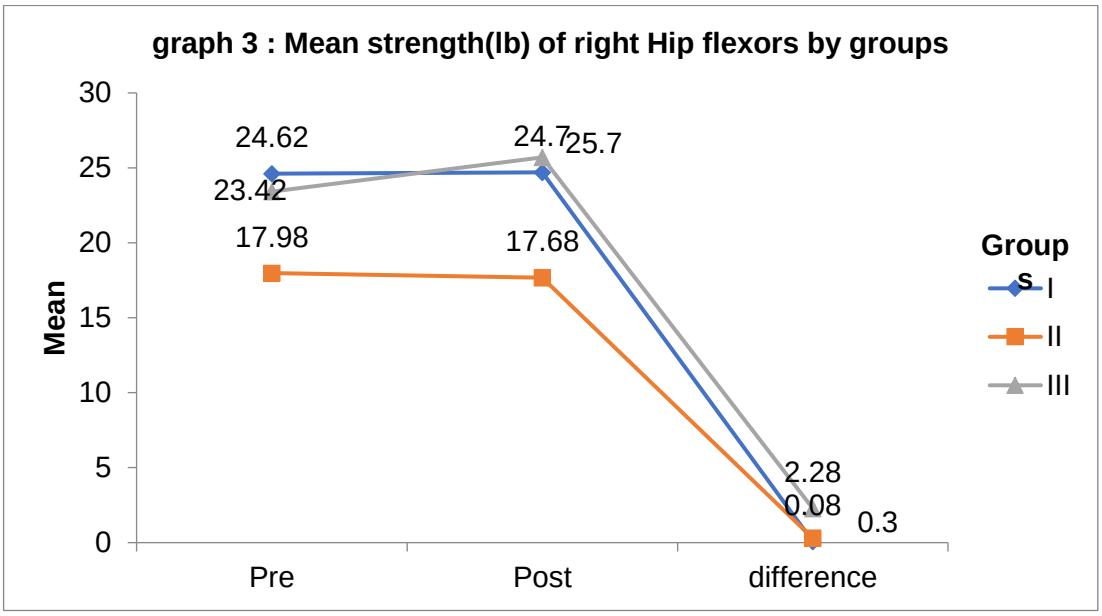

Graph 1 shows there was significant increase in mean strength of right quadriceps muscle in RT group compared to WB group.



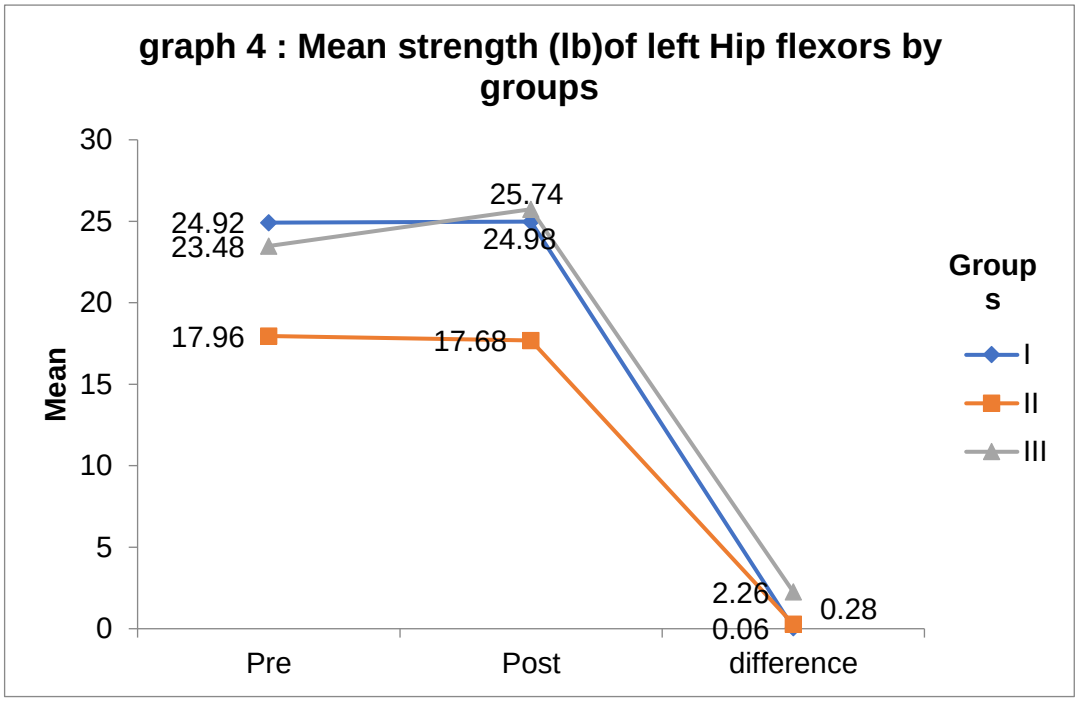

Graph 2 shows there was a significant increase in mean strength of left quadriceps muscle in RT group as compared to WB group

**Table 3 :** pair- wise comparison of mean difference of Hip flexors strength n= 150; 50 in each group

| Strength in lb | RIGHT pre | P value | RIGHT Post | P value | LEFT pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 6.64 | 0.000 | 7.02 | 0.00 | 6.96 | 0.000 | 7.3 | 0.00 |
| WB vs RT | 1.2 | 0.444 | 0.709 | 0.709 | 1.44 | 0.268 | 0.73 | 1.00 |
| CG vs RT | 5.44 | 0.000 | 8.02 | 0.000 | 5.52 | 0.000 | 8.06 | 0 |



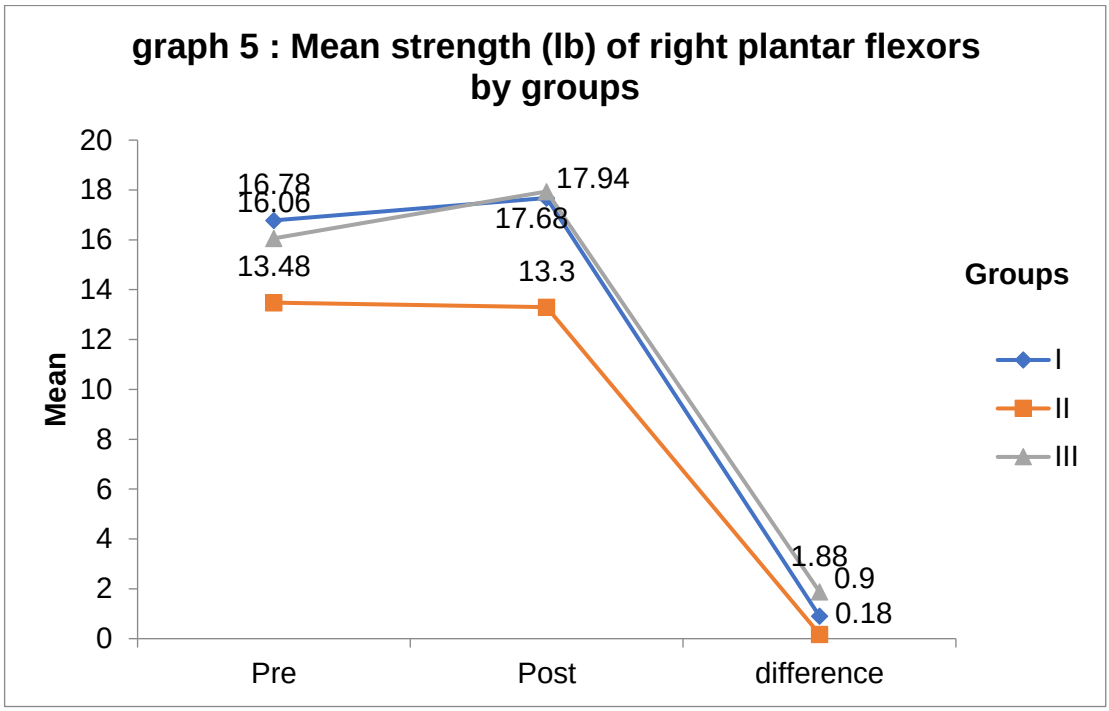

Graph 3 shows there was a significant increase in mean strength of right hip flexors in RT group as compared to WB group



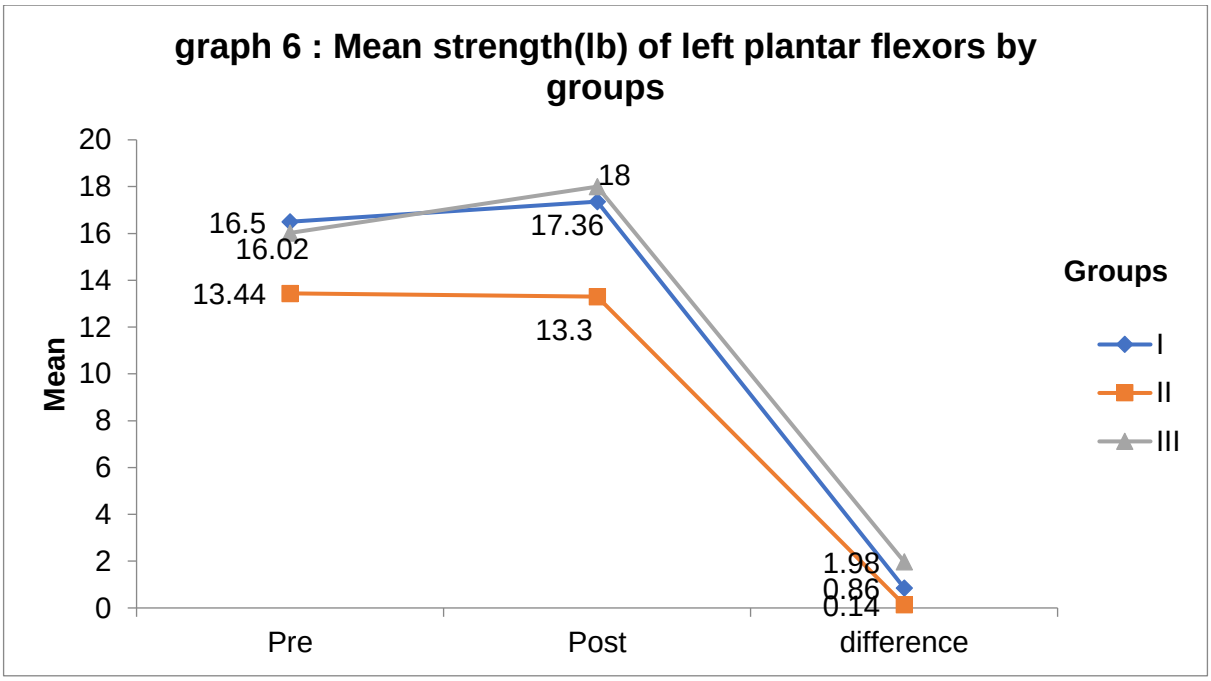

Graph 4 shows there was a significant increase in mean strength of left hip flexors in RT group as compared to WB group

**Table 4 :** pair- wise comparison of mean difference of plantar flexors strength
n= 150; 50 in each group

| Strength in lb | RIGHT Pre | P value | RIGHT Post | P value | LEFT pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 3.3 | 0.00 | 4.38 | 0.00 | 3.06 | 0.00 | 4.06 | 0.00 |
| WB vs RT | 0.72 | 0.684 | 0.26 | 1.00 | 0.48 | 1.00 | 0.64 | 0.807 |
| CG vs RT | 2.58 | 0.00 | 4.64 | 0 | 2.58 | 0.00 | 4.7 | 0.00 |



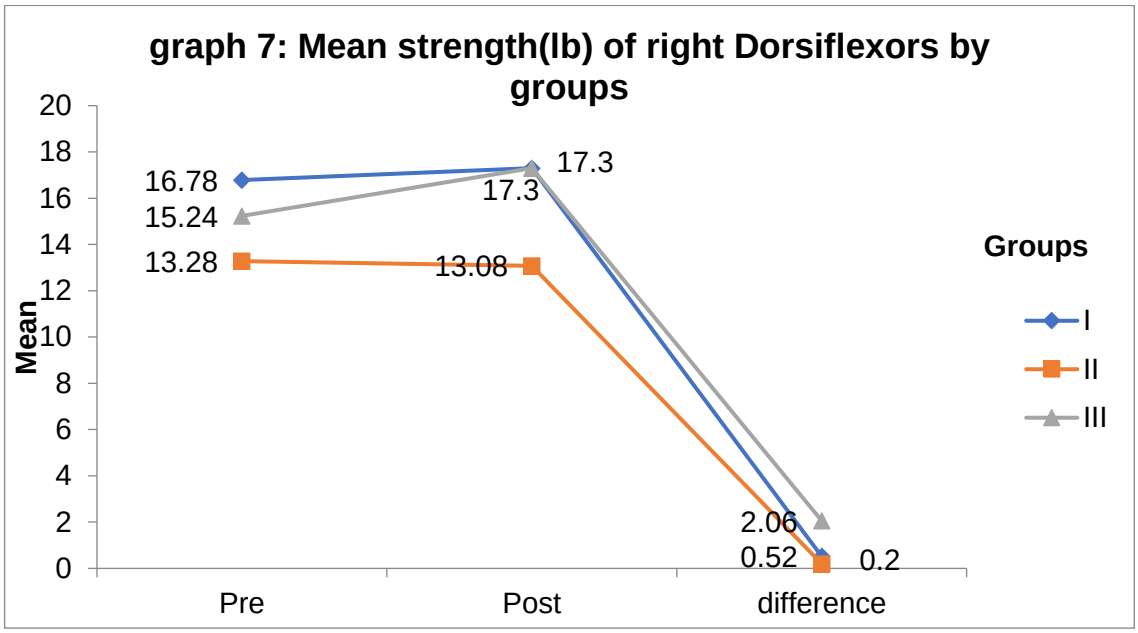

Graph 5 shows there was a significant improvement in mean strength of right plantar flexors in RT group as compared to WB group.



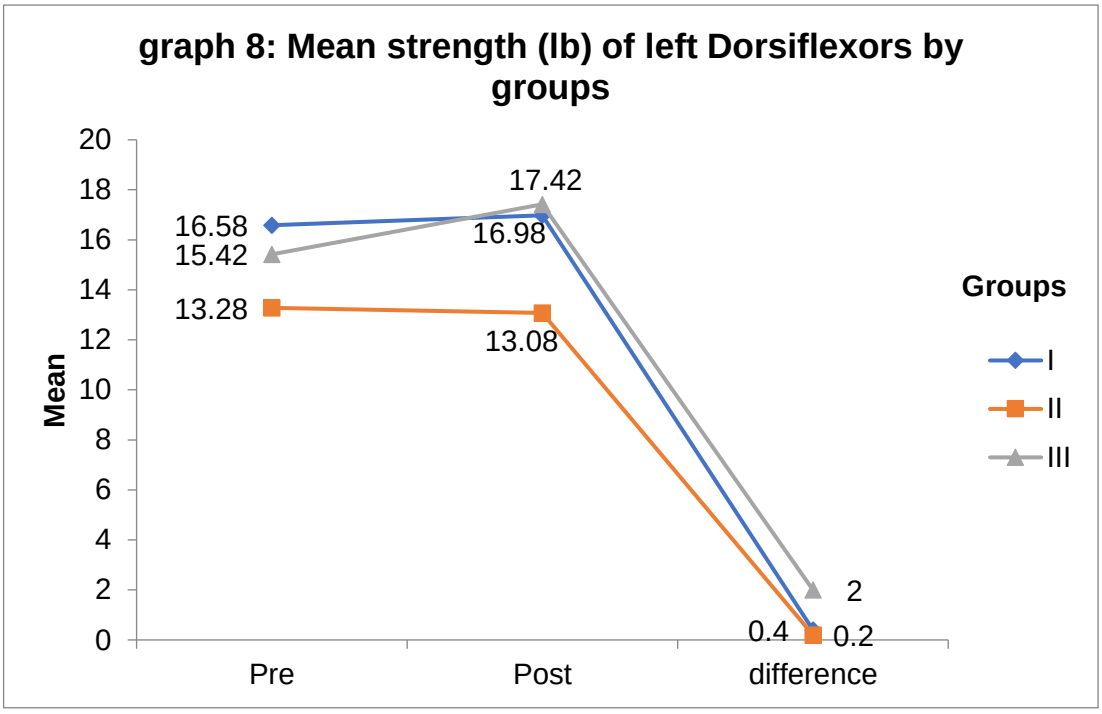

Graph 6 shows significant improvement in mean strength of left plantar flexors in RT group as compared to WB group

**Table 5 :** pair- wise comparison of mean difference of dorsi flexors strength n= 150; 50 in each group

| Strength in lb | RIGHT pre | P value | RIGHT Post | P value | LEFT pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 3.5 | 0.000 | 4.22 | 0.000 | 3.3 | 0.000 | 3.9 | 0.000 |
| WB vs RT | 1.54 | 0.045 | 0 | 1.000 | 1.16 | 0.122 | 0.44 | 1.000 |
| CG vs RT | 1.96 | 0.006 | 4.22 | 0.000 | 2.14 | 0.001 | 4.34 | 0.000 |



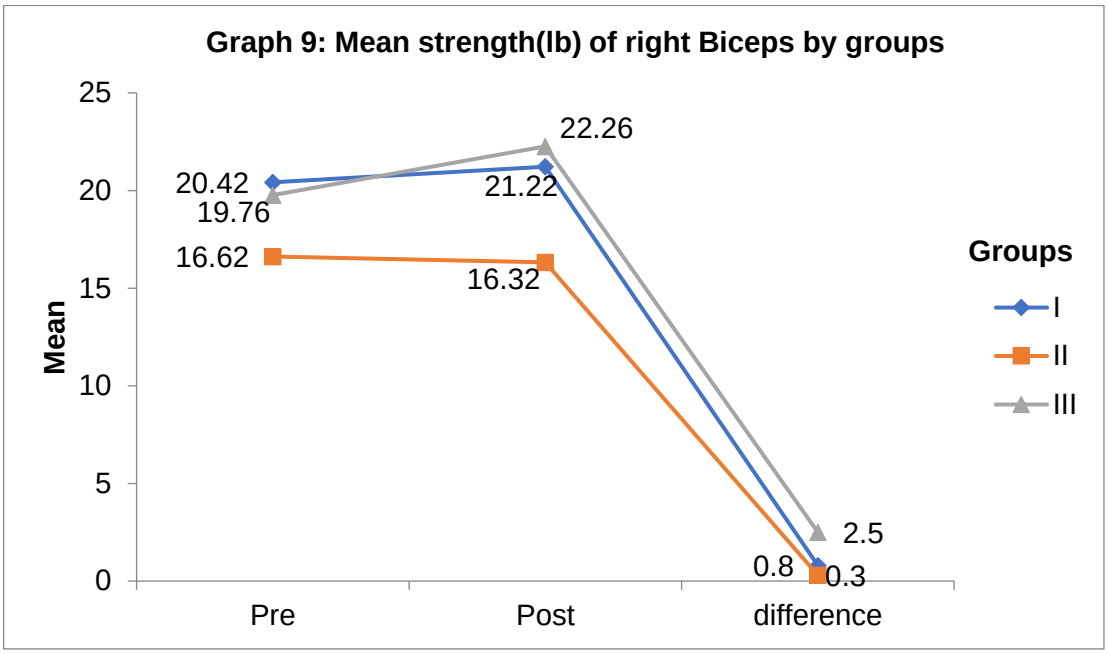

Graph 7 shows significant improvement in mean strength of right dorsiflexors in RT group as compared to WB group



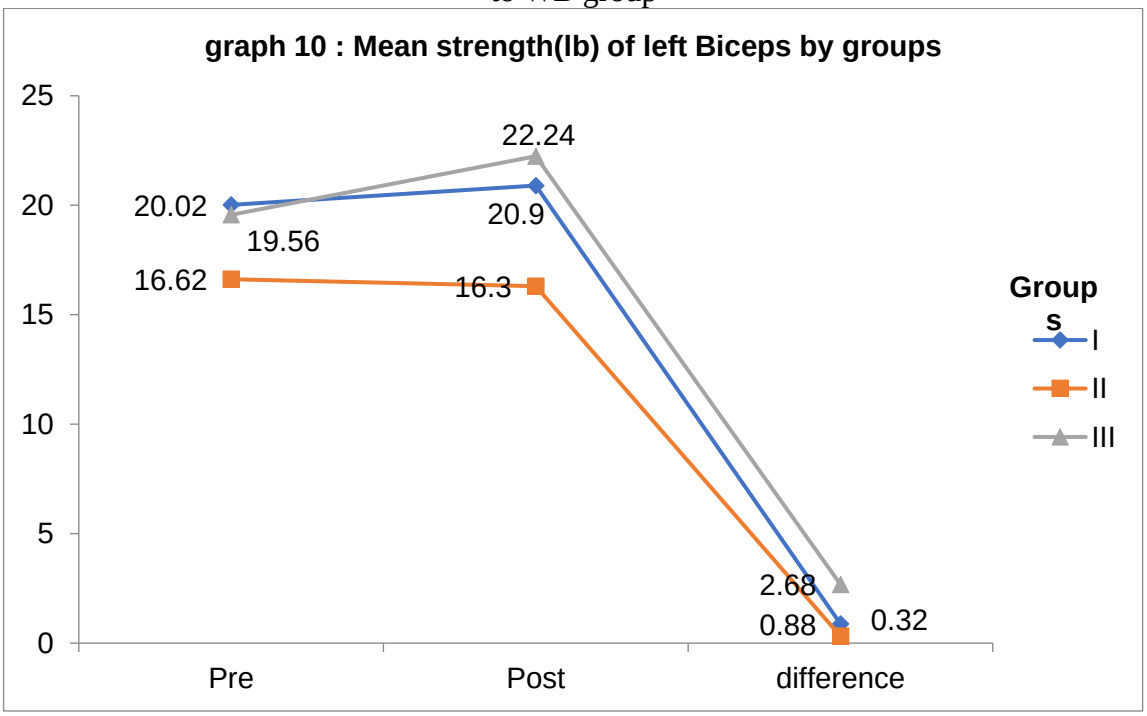

Graph 8 shows significant improvement in mean strength of left dorsiflexors in RT group as compared to WB group

**Table 6 :** pair- wise comparison of mean difference of biceps strength (lb)
n= 150; 50 in each group

| Strength in lb | RIGHT pre | P value | RIGHT Post | P value | LEFT pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 3.8 | 0.00 | 4.9 | 0.00 | 3.4 | 0.00 | 4.6 | 0.00 |
| WB vs RT | 0.66 | 0.856 | 1.04 | 0.297 | 0.46 | 1.00 | 1.34 | 0.113 |
| CG vs RT | 3.14 | 0.00 | 5.94 | 0.00 | 2.94 | 0.00 | 5.94 | 0.00 |



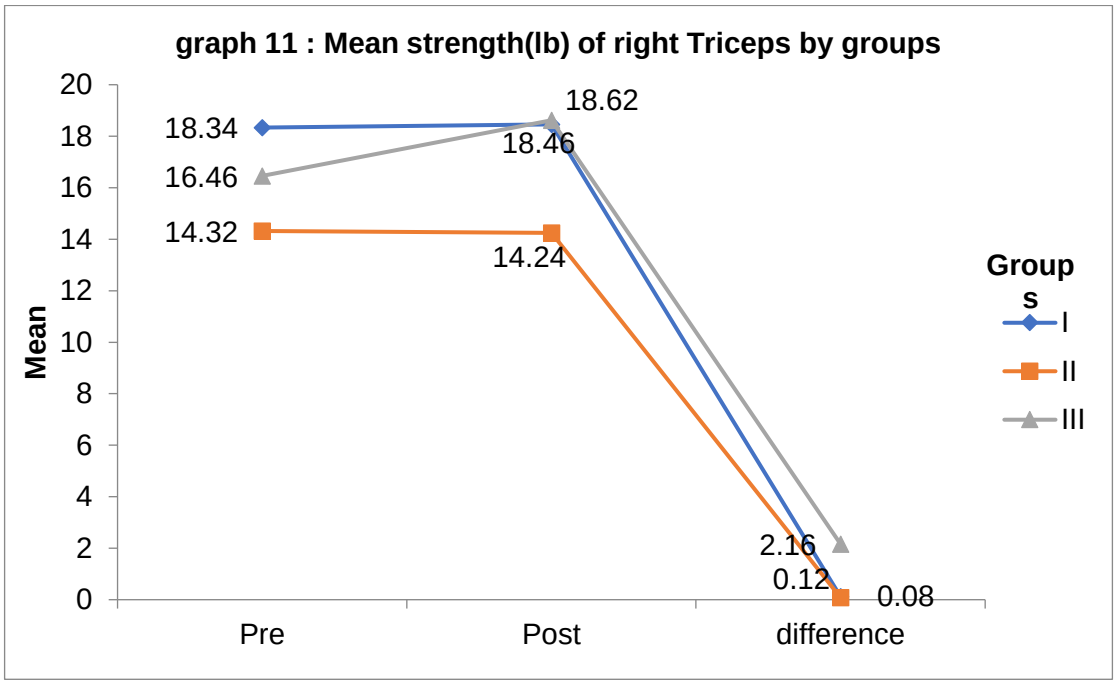

Graph 9 shows significant improvement in mean strength of right biceps in RT group as compared to WB group



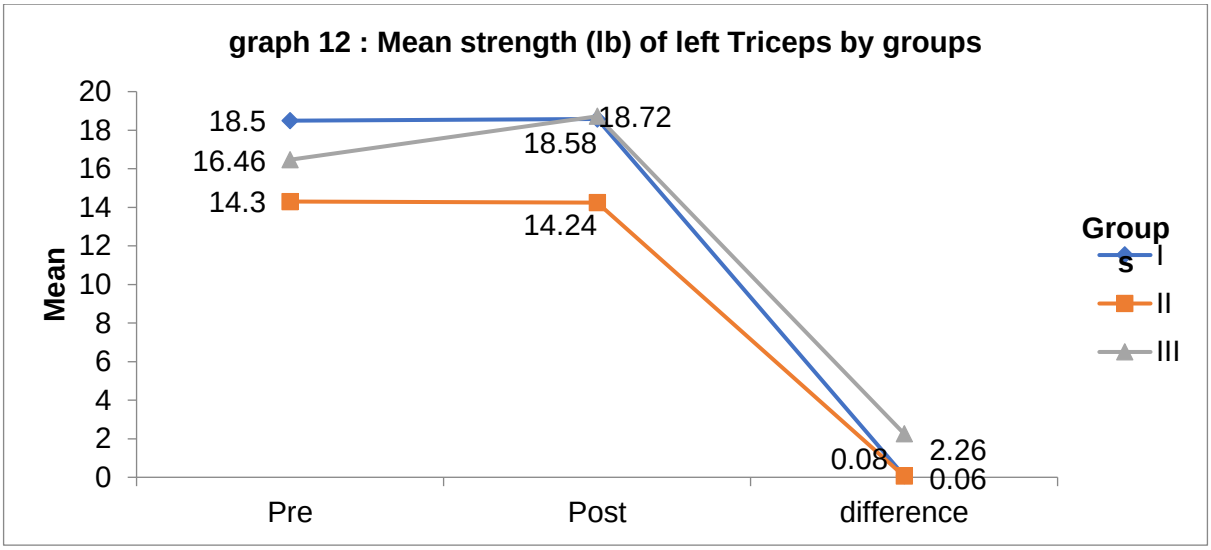

Graph 10 shows significant improvement in mean strength of left biceps in RT group as compared to WB group

**Table 7 :** pair- wise comparison of mean difference of triceps strength (lb)
n= 150; 50 in each group

| Strength in lb | RIGHT Pre | P value | RIGHT Post | P value | LEFT Pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 4.02 | 0.00 | 4.22 | 0.00 | 4.2 | 0.00 | 4.34 | 0.00 |
| WB vs RT | 1.88 | 0.004 | 0.16 | 1.00 | 2.04 | 0.003 | 0.14 | 1.00 |
| CG vs RT | 2.14 | 0.001 | 4.38 | 0.00 | 2.16 | 0.001 | 4.48 | 0.00 |



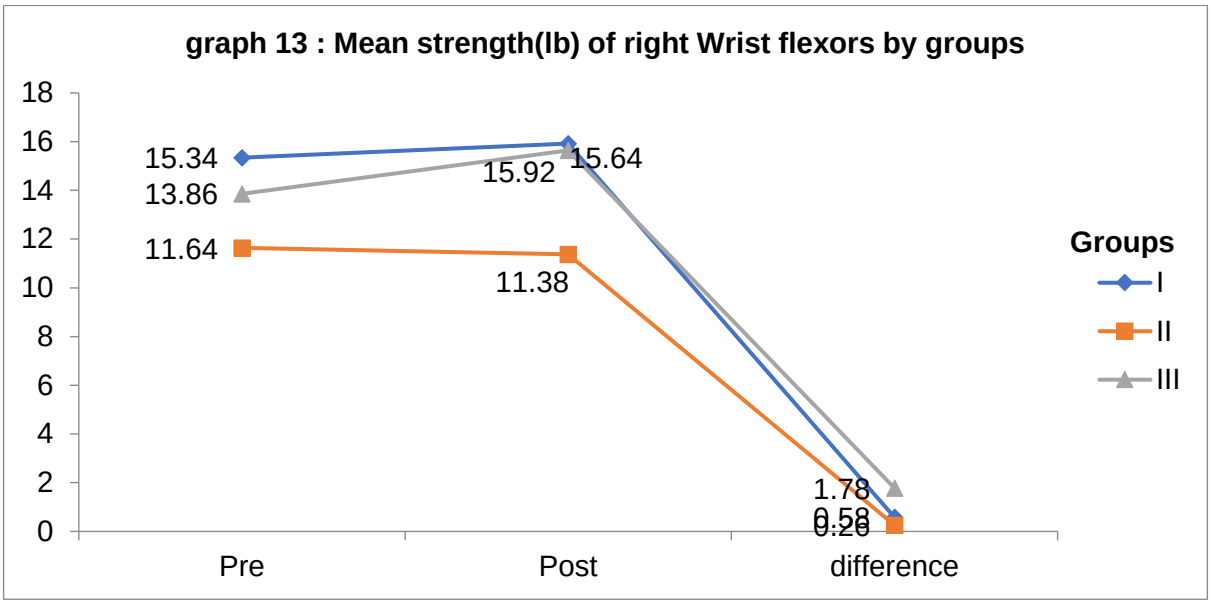

Graph 11 shows significant improvement in mean strength of right triceps in RT group as compared to WB group



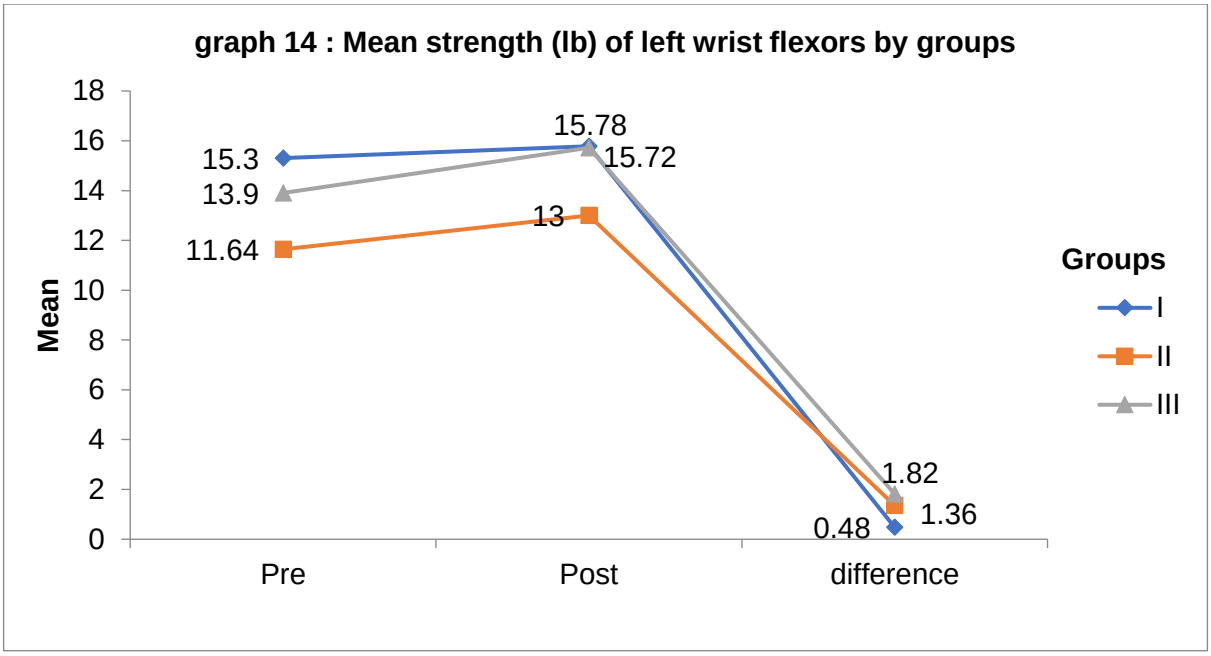

Graph 12 shows significant improvement in mean strength of left triceps in RT group as compared to WB group

**Table 8:** pair- wise comparison of mean difference of wrist flexors strength (lb)
n= 150; 50 in each group

| Strength in lb | RIGHT Pre | P value | RIGHT Post | P value | LEFT pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 3.7 | 0.00 | 4.54 | 0.00 | 3.66 | 0.00 | 2.78 | 0.138 |
| WB vs RT | 1.48 | 0.013 | 0.28 | 1.00 | 1.4 | 0.018 | 0.06 | 1.00 |
| CG vs RT | 2.22 | 0.00 | 4.26 | 0.00 | 2.26 | 0.00 | 2.72 | 0.153 |



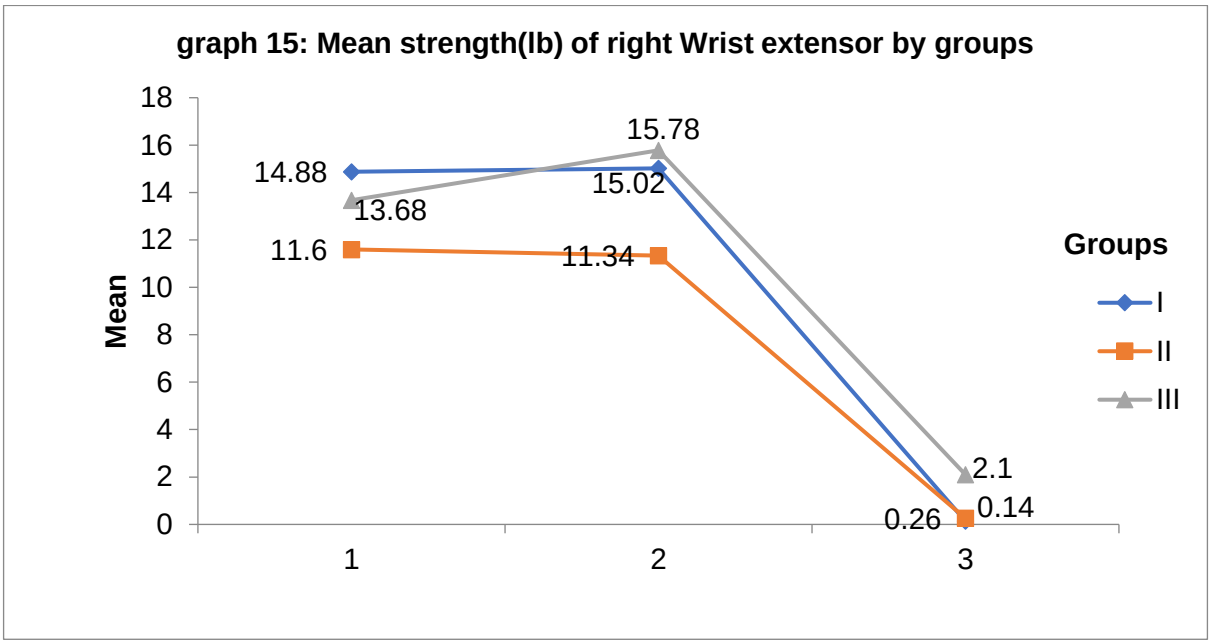

Graph 13 shows significant improvement in mean strength of right wrist flexors in RT group as compared to WB group



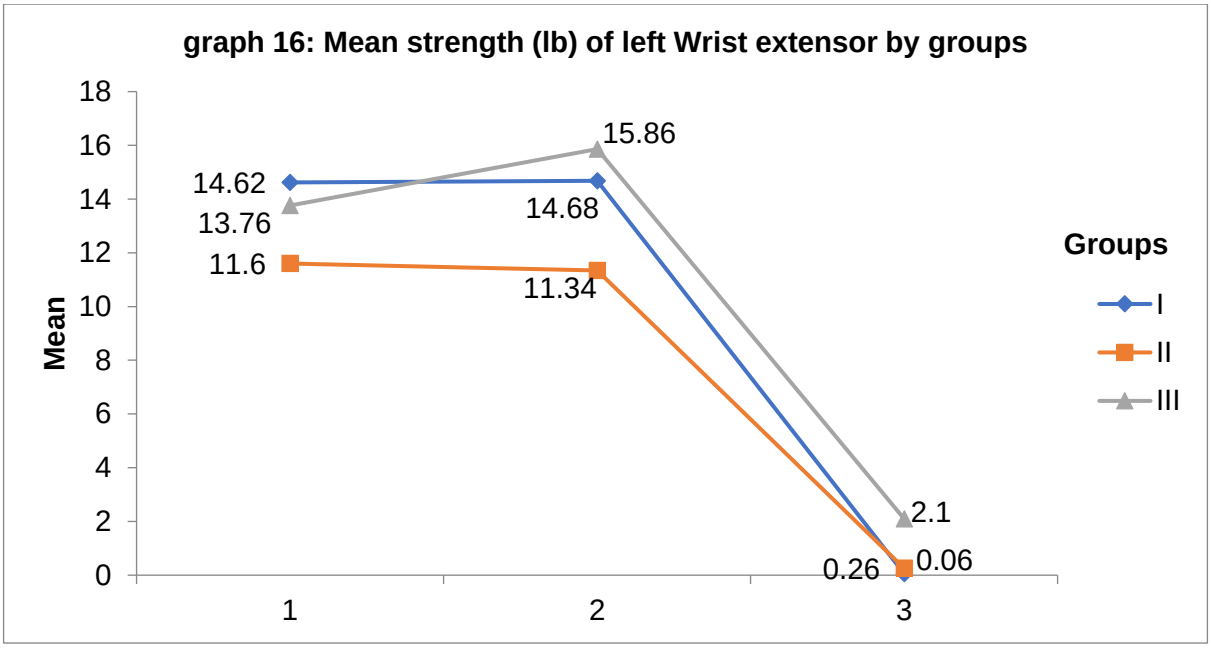

Graph 14 shows significant improvement in mean strength of left wrist flexors in RT group as compared to WB group

**Table 9:** pair- wise comparison of mean difference of wrist extensors strength (lb) n= 150; 50 in each group

| Strength in lb | RIGHT Pre | P value | RIGHT Post | P value | LEFT pre | P value | LEFT Post | P value |
|---|---|---|---|---|---|---|---|---|
| WB vs CG | 3.28 | 0.00 | 3.68 | 0.00 | 3.02 | 3.020 | 3.34 | 0.00 |
| WB vs RT | 1.2 | 0.094 | 0.76 | 0.519 | 0.86 | 0.860 | 1.18 | 0.057 |
| CG vs RT | 2.08 | 0.001 | 4.44 | 0.00 | 2.16 | 2.160 | 4.52 | 0.00 |



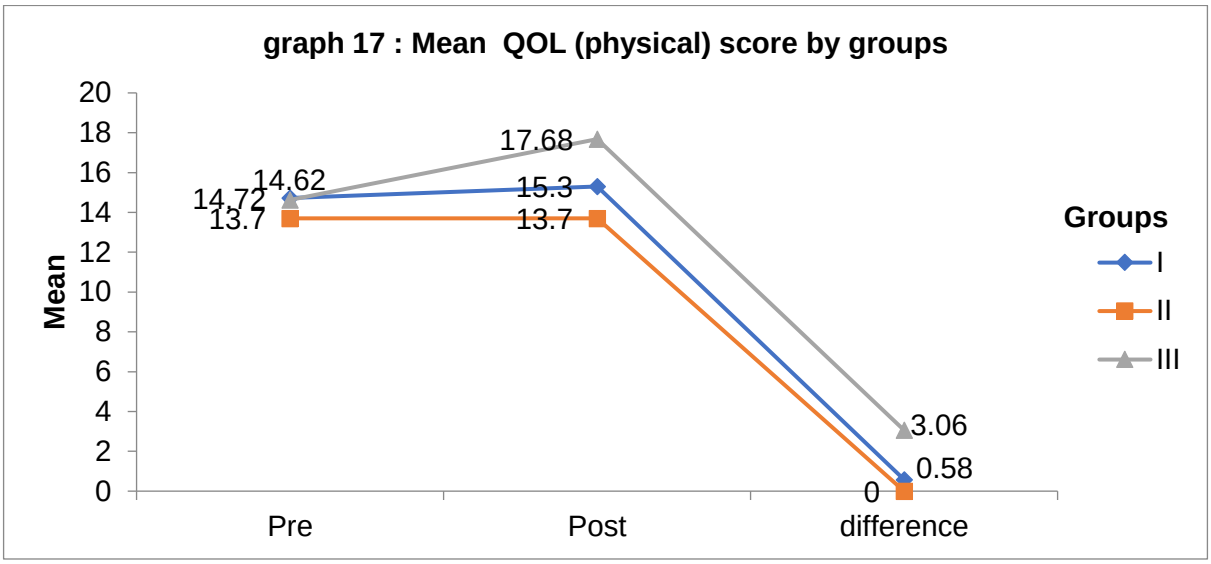

Graph 15 shows significant improvement in mean strength of right wrist extensors in RT group as compared to WB group




Graph 16 shows significant improvement in mean strength of left wrist extensors in RT group as compared to WB group

**Table 10:** pair wise comparison of mean difference of QOL physical score

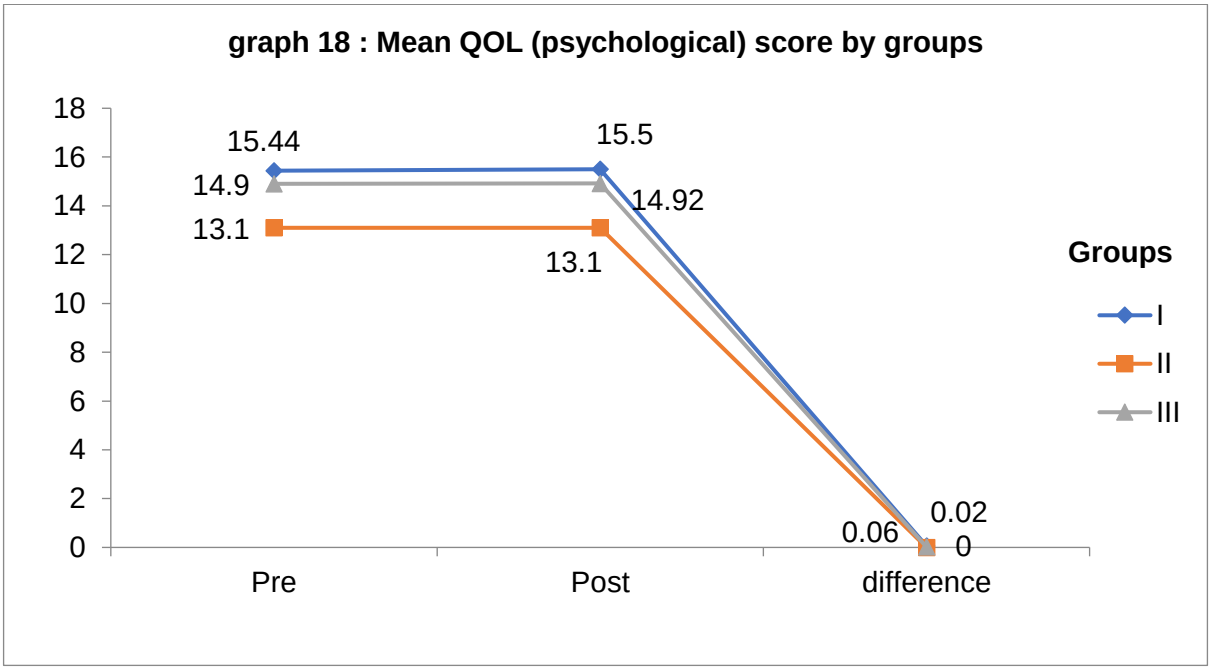
| | Pre | p- value | Post | p- value |
|---|---|---|---|---|
| WB vs CG | 1.02 | 0.001 | 1.6 | 1.00 |
| WB vs RT | 0.1 | 1.000 | 2.38 | 0.971 |
| CG vs RT | 0.92 | 0.005 | 3.98 | 0.300 |




Graph 17 shows significant improvement in mean QOL physical score on BREF in RT group as compared to WB group

**Table 11:** pair wise comparison of mean difference of QOL psychological score

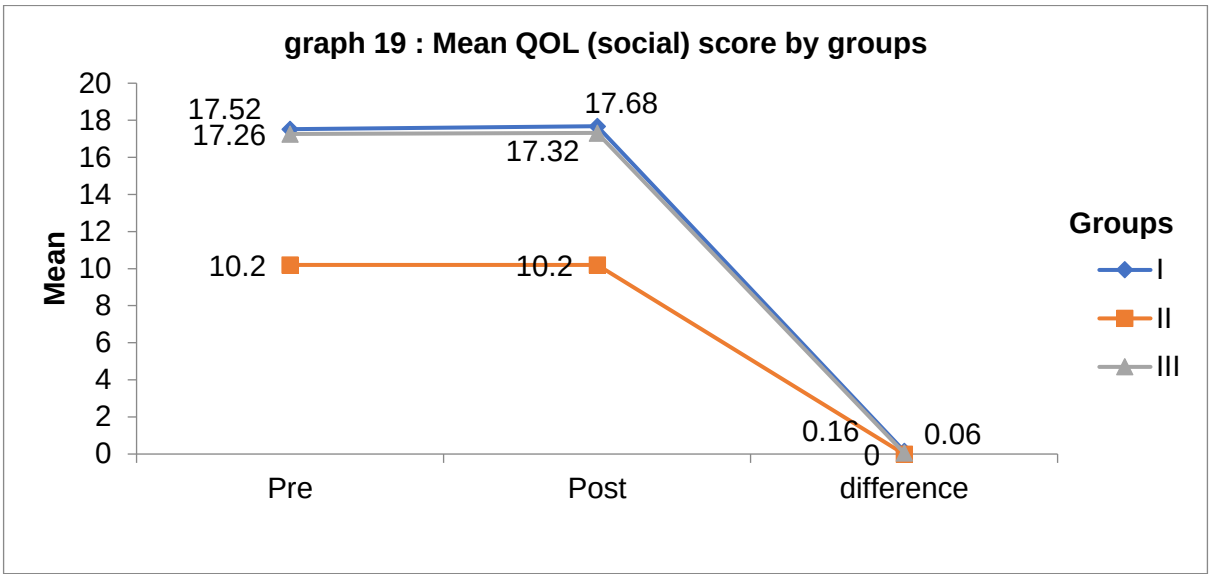
| | Pre | P value | Post | P value |
|---|---|---|---|---|
| WB vs CG | 2.34 | 0.00 | 2.4 | 0.00 |
| WB vs RT | 0.54 | 0.259 | 0.58 | 0.189 |
| CG vs RT | 1.8 | 0.00 | 1.82 | 0.00 |




Graph 18 shows significant increase in mean QOL psychological score on BREF in WB group as compared to RT group

**Table 12:** pair wise comparison of mean difference of QOL social score

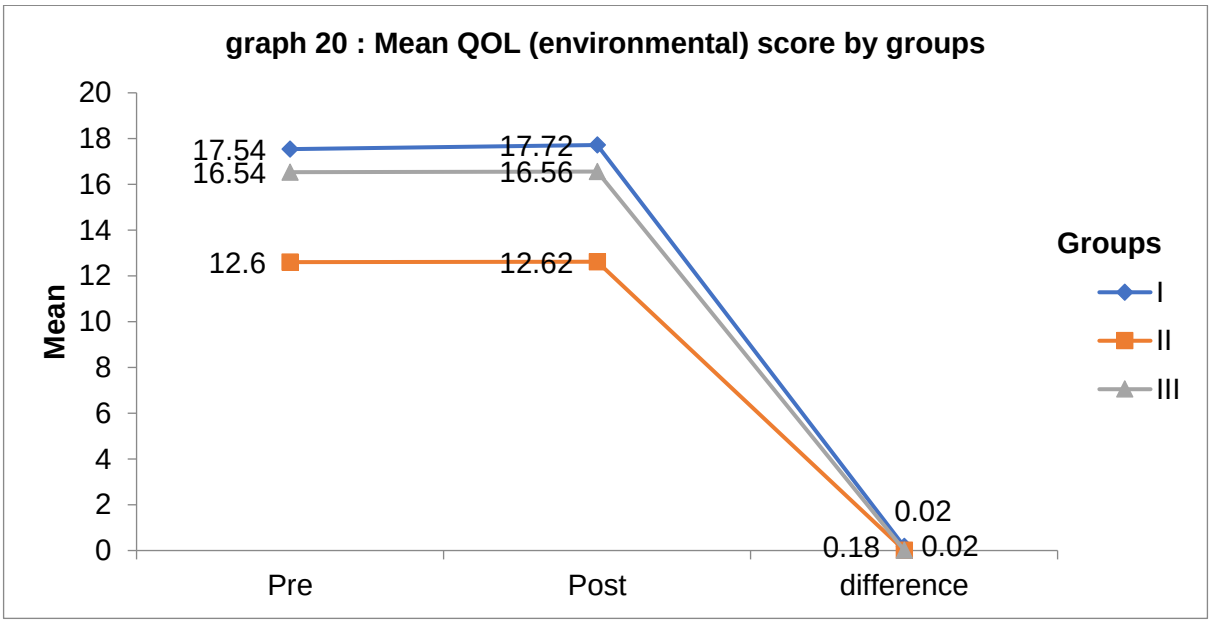
| | Pre | P value | Post | P value |
|---|---|---|---|---|
| WB vs CG | 7.32 | 0.00 | 7.48 | 0.00 |
| WB vs RT | 0.26 | 1.00 | 0.36 | 1.00 |
| CG vs RT | 7.06 | 0.00 | 7.12 | 0.00 |




Graph 19 shows significant improvement in mean QOL social score on BREF in WB group as compared to RT group

**Table 13:** pair wise comparison of mean difference of QOL environmental score

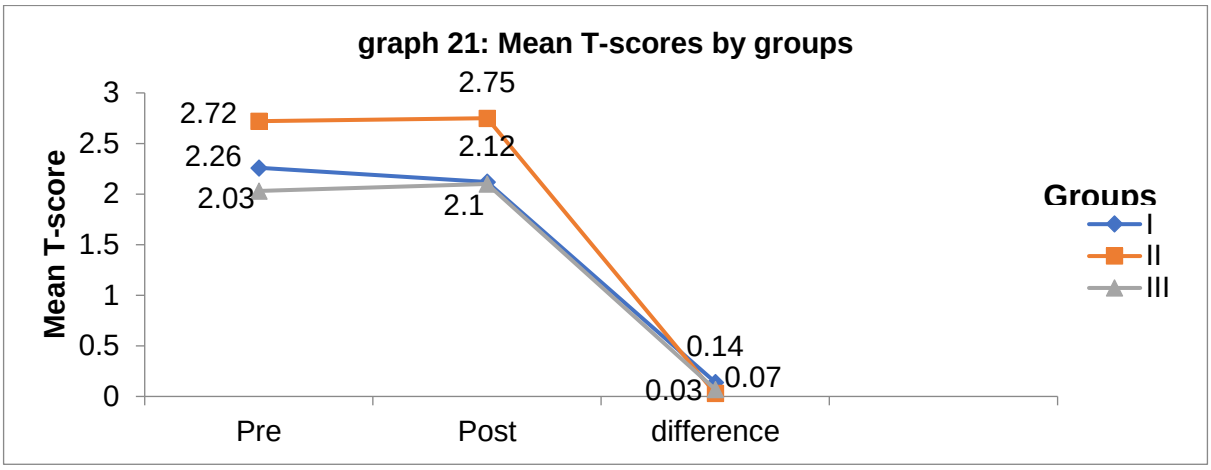
| | Pre | P value | Post | P value |
|---|---|---|---|---|
| WB vs CG | 4.94 | 0.00 | 5.1 | 0.00 |
| WB vs RT | 1 | 0.002 | 1.16 | 0.000 |
| CG vs RT | 3.94 | 0.00 | 3.94 | 0.00 |



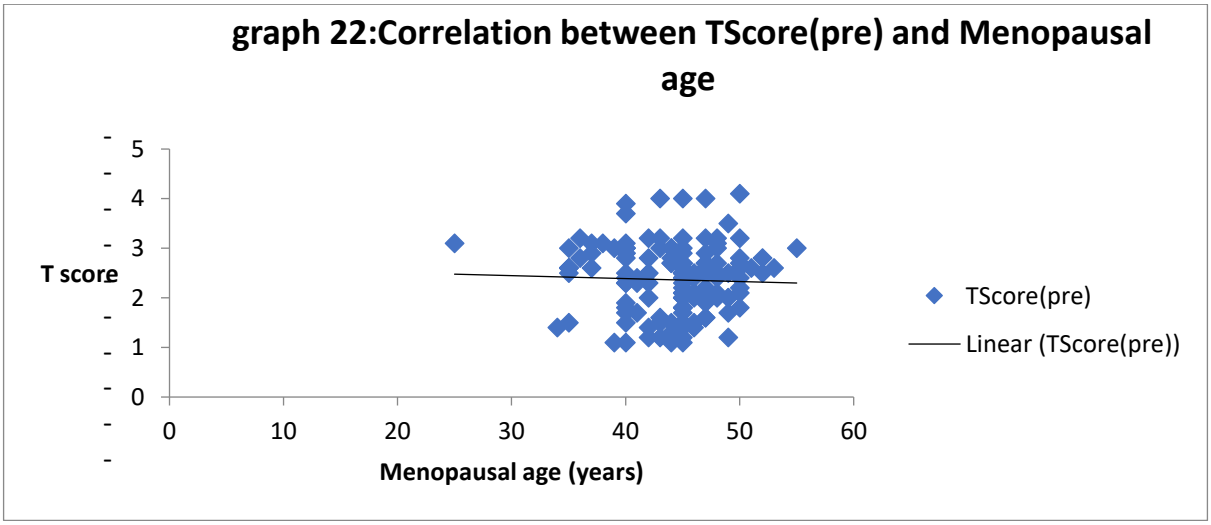

Graph 20 shows significant improvement in mean QOL environmental score on BREF in WB group as compared to RT group

**Table 14:** pair wise comparison of mean difference of T score (SD)

| | Pre | P value | Post | P value |
|---|---|---|---|---|
| WB vs CG | 0.464 | 0.003 | 0.636 | 0.001 |
| WB vs RT | 0.228 | 0.303 | 0.016 | 1.000 |
| CG vs RT | 0.692 | 0.001 | 0.652 | 0.001 |




Graph 21 sows significant improvement in mean T score in WB group as compared to RT group




Graph 22 shows negative correlation between T score and menopausal age. As menopausal age increases, T score decreases

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