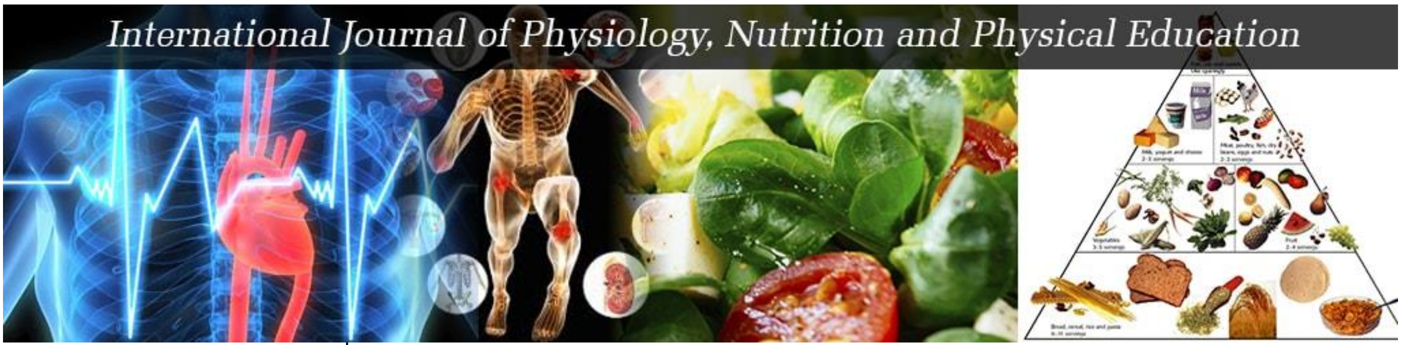


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# Effect of aerobic exercise with functional training and dietary calcium supplementation on body composition among men with osteopenia

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**Abstract**
The purpose of the study was to examine the effect of aerobic exercise with functional training and dietary calcium supplementation on selected body composition parameters among men with Osteopenia. The cross-sectional investigation of bone health and nutrition a total of 165 male aged 50-60 years were selected from Salem and surrounding communities. The screening of body composition was carried out at shri Gokulam Hospital by using DEXA scan; among 165 male, 88 male are having osteopenia. From this 88 male, 40 male Osteopenia subjects were randomly selected. The subjects were assigned into two group's namely Experimental group I underwent Aerobic exercise with functional strength training (AEFST), experimental group II underwent only Dietary supplementation (DS), experimental group III underwent Combined training (CAEFST & DS) for a period of twelve weeks, five days per week and group VI acted as control group. The study was formulated as a true random group design consisting of pre - test and post –test. The experimental group participated in the treatment for a period of 12 weeks. Initial test were conducted for all the subjects on selected body composition parameters like Fat Mass, Lean Mass and Bone Mineral Density by using Dual-Energy X-ray Absorptiometry (DXA, DPX-NT, NT+73679 GE LUNAR MEDICAL SYSTEM) of the Whole Body scan. The post-test is conducted on the above said parameters after the 12 weeks for the four groups. The results proved that there was a significant reduction in fat mass, increase in muscle mass and significant improvement in bone mineral density among men with Osteopenia.

**Keywords:** Osteopenia, fat mass, lean mass and bone mineral density

## Introduction
The prevalence of osteoporosis in India is very high both in men and women. The symptoms are primarily a consequence of reduced bone mineral density. The United States Library of Medicine has confirmed it as the most familiar type of bone disease that has become a silent epidemic and recognized as a major health problem throughout the world (Hima Bindu & Naga Anusha, *et al*, 2011) [9]. Bone is a dynamic structure, in a constant state of destruction and re-building. The processes of bone formation and resorption remain in balance in the healthy patient, resulting in a constant turnover of bone and maintenance of bone density. The decrease in bone density that is the hallmark of osteoporosis results from an imbalance in the formation-resorption processes, which result in either an increase in the bone's resorptive process or a decrease in the bone's formative process. Osteoblasts, derived from mesenchymal stem cells, are responsible for bone formation while osteoclasts, derived from hematopoietic precursor cells, are responsible for bone resorption. These two types of cells are linked not only in function but in production, as the development of osteoclasts from hematopoietic precursors cannot be accomplished unless mesenchymal cells are present. The optimization of bone mineral density include adequate dietary calcium intake and physical activity. Low dietary calcium or low absorption of calcium may be a major risk factor for the development of osteoporosis (Nordin *et al*., 1985) [16].

## Osteoporosis in men
Bone mass achieved during growth to young adulthood is lost just under half over a man's lifetime. The loss of bone is the same as the quantity lost in women but men compensate better by placing down more new bone on the exterior surface of the bone as part of the natural

process of bone remodeling (Seeman, 1995) [18]. However, this addition of new bone on the exterior surface does not completely compensate for the loss of bone in inside surface and so one in five men over 50 will have a bone fracture that decreases the quality of their lives, and lessens the length of their lives.

The strain characteristics of the older adult bone differ from those of younger bones. The decrease in ultimate strain relates to the inability of the bone as a whole to a bend. Bones of the elderly people can withstand about of the strain of the bones of the younger adults. The bones of the elderly people are less ductile and less able to store energy to failure (Nordin and Frankel, 1989) [15]. The decrease in ultimate strain is the most important age change in bone (Burstein, Reilly & Martens 1976; Burstein, Currey, Frankel & Reilly, 1972) [3, 4]. All these changes associated with aging should be because of more sedentary life style of older people and due to physical inactivity. The risk factors are similar, such as: age, gender, menopause, family history, low body weight, medical history, calcium and Vitamin D deficiency, not eating enough fruits and vegetables, having high protein, sodium and caffeine, sedentary lifestyle for long time, excessive alcohol consumption, smoking and delayed puberty in male (Chestnut, 1994) [6].

**Aerobic exercise**

Aerobic exercise also increases bone mass by using body weight as the resistance. Walking and running are great ways to increase or maintain bone mass while increasing cardiovascular fitness (Beck, 2003) [1]. Aerobic exercise training maintains or slows the loss of bone mineral density with both high- and low-impact exercise effective in maintaining bone mineral density. But aerobic activity that is non weight-bearing (such as swimming or cycling) does not enhance bone density.

**Functional strength training**

Functional exercise training helps to improve fitness levels of older adults. The goal of maintaining independence becomes increasingly important for the aging adult; thus, creating exercise programs that improve functional fitness and contribute to prolonged independent living is a critical task **(**Milton, 2008) [11]. Functional training as the ability to stabilize the body through dynamic and isometric contractions in response to stressors such as gravity, momentum and ground reaction forces which is needed for the elderly men to meet their regularly incorporate into their exercise routine (Cosio-Lima Reynolds, Winter, Paolone and Jones, 2003) [5]. While resistance exercise has been used extensively during the past decade to promote strength, muscle hypertrophy, and mobility in the elderly .The idea that exercise should be strict linear movements typical of resistance machines and free weights may be impractical for many older adults. Rather, a functional exercise, particularly one performed in a functional training, may be well suited to older persons wishing to improve function and mobility (Weiss *et al* 2010) [22].

**Dietary supplementation**

Life is nominated by food and the substances in food on which life depends are the nutrient. These provide the energy and building materials for countless substances that are essential for the growth and survival of living things. Nutrients become integral parts of the body and contribute to its function, depend on the physiologic and bio-chemical processes that govern their actions. Bones are more at risk to break if proteins and minerals (calcium and phosphate) are insufficient. Excess calcium and phosphate absorption also causes bone to lose density as a person ages. The NOF (2011) also states that bone health can also be achieved by getting adequate protein in the amounts of 5 ounces per day for a woman and 5.5 ounces per day for men.

**Calcium and Bone**

Calcium is the predominant component of bone being the largest constituent of the hydroxyapatite crystals or solid particles. The body prioritizes maintenances of blood calcium levels over those of bone tissue. Approximately 99% of the calcium stores are found in bone (Volpe, 1999) [20]. Dietary intake of calcium has a strong relationship with bone mineral density because 40% of the mineral found in bone is calcium. Calcium is absorbed both actively and passively through the small intestine (Bronner and Pansu, 1999) [2].

**Formulation of dietary supplement**

The health mix was formulated with ingredients namely ragi flour, soya flour, wheat flour, milk powder, flax seeds, sesame seeds and oats were purchased from local market, cleaned, dried roasted separately and powdered. Finally all the ingredients were mixed with milk Powder and water, and pressure cooked well uniformly.

The method of preparation of the health mix selected for the study is given below:

**Ingredients**

| **Ingredients** | **Health mix (100 gram)** |
|---|---|
| Ragi flour | 50 gram |
| Soya flour | 10 gram |
| Wheat flour | 10 gram |
| Milk powder | 10 gram |
| Sesame seeds | 10 gram |
| Oats | 5 gram |
| Flax seeds | 5 gram |

**Nutrient analysis of health mix powder**

The selected health mix powder was subjected for major and micro nutrient. Major nutrients like carbohydrate, protein and fat were analysed. Micro nutrients like Calcium were also analysed. Moisture, Ash and Energy was also analysed. The presence of non-nutrient factor like phenolic compounds and toxic materials were analysed by using standard procedure in the Food Analysis Laboratory.

**Nutrients calculation of the standardized health mix powder**

The prepared health mix using ragi flour, soya flour, wheat flour, milk powder, flax seeds, sesame seeds and oats with maximum acceptability levels was selected for the following nutrients calculation namely energy, carbohydrate, protein, fat and calcium using National Institute of Nutrition [NIN] standard procedure [1996].

**Approximate principles of the health mix**

| Approximate principle | Health mix |
|---|---|
| Energy(kcal) | 400 |
| Carbohydrate(g) | 56 |
| Protein(g) | 15 |
| Fat(g) | 5.5 |
| Moisture(g) | 1.7 |
| Ash(g) | 3.96 |
| Calcium(mg) | 455 |

### Shelf life study of the health mix powder

Health mixes were evaluated for the total bacterial count (TBC) present. The health mix were packed in a polythene bag and kept for about 90 days. The health mixes were evaluated for microbial testing at the beginning and at the end of 90 days storage and the quality was evaluated.

### Methodology

For the purpose of the cross-sectional investigation of bone health and nutrition a total of 165 male aged 50-60 years were selected from Salem and surrounding communities. The screening of body composition was carried out at shri Gokulam Hospital by using DEXA scan; among 165 male 88 male are having osteopenia. To find out the bone mineral density, Quantitative Ultra Sound scan was used (see the table-I). From the above test 165 (43%) subjects were identified low bone mineral density (Osteopenia). For the purpose of the present study, from the above, 40 subjects were randomly selected as subjects and their age ranged between 50-60 years.

The selected subjects were assigned into three experimental groups and a control group with ten subjects in each (n=10). Experimental group I underwent Aerobic exercise with functional strength training (AEFST), experimental group II underwent only Dietary supplementation (DS), experimental group III underwent Combined training (CAEFST & DS) for a period of twelve weeks, five days per week and group VI acted as control group. The experimental groups participated in their treatment for a period of 12 weeks. The post-test is conducted on the above said parameters after the 12 weeks for the two groups. Experimental group I underwent aerobic exercise with functional strength training, Experimental group II underwent only dietary supplementation and Experimental group III underwent aerobic exercise with functional strength training and dietary supplementation.

Functional strength training was performed at a moderate intensity of 9 exercise were completed 5 days a week for 4 weeks at an intensity of 55-60% for 1-4 weeks. Functional strength training was progressed at 5-8 weeks by 60-65% and 65-70 % for 9-12 weeks was maintained across the training program. The functional strength training program consisted of multijoint/ multiplanar exercises completed using Swiss ball, theratube and dumbbell. The major muscles or muscle groups that the functional strength training exercises involved were the quadriceps group (Swiss ball squat and Swiss ball lunges), hamstring group (Swiss ball squat and Swiss ball lunges), gluteus maximus (Swiss ball squat and Swiss ball lunges), gastrocnemius (single leg balance), and anterior, lateral and posterior core muscle groups (plank and side plank), pectoralis major (push-up and modified push-up), triceps brachii (push-up and modified push-up), biceps brachii (theraband rowing), anterior deltoid (Thera band shoulder press), posterior deltoid (Thera Band Shoulder Press, theraband rowing), latissimus dorsi (theraband rowing), rhomboids (theraband rowing).

The Dietary supplementation was taken by experimental Group II and III. Subjects in the experimental groups consumed 100 grams of health mix supplement for period of 12 weeks. Daily 100gm of health mix supplement was given in the morning.

### Result and Discussion

**Table I:** Computation of analysis of covariance on fat mass

| Test | Aefstg | DSG | AEFST & DSG | CG | Source of Variance | Sum of squares | df | Mean Squares | F- ratio |
|---|---|---|---|---|---|---|---|---|---|
| Pre Test Means | 23.60 | 26.53 | 24.26 | 23.44 | BG | 61.135 | 3 | 20.378 | 1.01 |
| | | | | | WG | 728.696 | 36 | 20.242 | |
| Post-test Means | 21.29 | 26.30 | 21.73 | 23.74 | BG | 156.937 | 3 | 52.312 | 3.18* |
| | | | | | WG | 592.634 | 36 | 16.462 | |
| Adjusted Post Means | 22.06 | 24.44 | 21.91 | 24.65 | BG | 65.289 | 3 | 21.763 | 109.80* |
| | | | | | WG | 6.937 | 35 | 0.198 | |

*Significant at 0.05 level (2.87).

**Table II:** Scheffe's post hoc test on fat mass (Scores in Kg)

| Adjusted Post- test Means | | | | Mean Difference | Confidence Interval |
|---|---|---|---|---|---|
| CG | AEFSTG | DSG | AEFST & DSG | | |
| 24.65 | 22.06 | - | - | **2.59*** | 0.58 |
| 24.65 | - | 24.44 | - | 0.21 | 0.58 |
| 24.65 | - | - | 21.91 | **2.75*** | 0.58 |
| - | 22.06 | 24.44 | - | **2.38*** | 0.58 |
| - | 22.06 | - | 21.91 | 0.16 | 0.58 |
| - | - | 24.44 | 21.91 | **2.53*** | 0.58 |

Table I shows that the obtained F value on pre test scores on Fat mass was 0.47 lesser than the required value of 2.87 to be significant at 0.05 level. This proved there is no significant difference between the groups at initial stage and the randomizations at the initial stage are equal. The obtained post-test F value of 3.18 was greater than the required F value of 2.87. Further, the obtained adjusted post-test F value of 109.80 was greater than the required F value of 2.87. The results presented in Table 2 proved that there was no significant difference between, Dietary supplementation group and control group, Aerobic exercise with functional strength training group and combined training group at 0.05 level of confidence with the confidence interval value of 0.58. It was also concluded that the combined Aerobic exercise with functional strength and dietary supplementation treatment was better than dietary supplementation alone in changing fat mass.

**Table III:** Computation of analysis of covariance on lean mass

| Test | AEFSTG | DSG | AEFST & DSG | CG | Source of Variance | Sum of squares | df | Mean Squares | F- ratio |
|---|---|---|---|---|---|---|---|---|---|
| Pre Test Means | 42.54 | 42.58 | 42.14 | 41.35 | BG | 9.771 | 3 | 3.257 | 1.37 |
| | | | | | WG | 85.409 | 36 | 2.372 | |
| Post-test Means | 44.24 | 42.70 | 43.95 | 41.29 | BG | 54.461 | 3 | 18.154 | 7.98* |
| | | | | | WG | 81.938 | 36 | 2.276 | |
| Adjusted Post Means | 43.91 | 42.33 | 43.96 | 41.98 | BG | 31.380 | 3 | 10.460 | 20.01* |
| | | | | | WG | 18.292 | 35 | 0.523 | |

*Significant at 0.05 level (2.87).

Table III shows that the obtained F value on pre test scores on Lean mass was 1.37 lesser than the required value of 2.87 to be significant at 0.05 level. The obtained post-test F value of 7.98 was greater than the required F value of 2.87. Further, the obtained adjusted post-test F value of 20.01 was greater than the required F value of 2.87. The results presented in Table IV proved that there were no significant differences between, Dietary supplementation group and control group and Aerobic exercise with functional strength training group and combined group at 0.05 level of confidence with the confidence interval value of 0.95. It was also concluded that the combined training was better than dietary supplementation in altering lean body mass.

**Table IV:** Scheffe's post hoc test on lean body mass (Scores in Kg)

| Adjusted Post- test Means | | | | Mean Difference | Confidence Interval |
|---|---|---|---|---|---|
| CG | AEFSTG | DSG | AEFST & DSG | | |
| 41.98 | 43.91 | - | - | 1.92* | 0.95 |
| 41.98 | - | 42.33 | - | 0.35 | 0.95 |
| 41.98 | - | - | 43.96 | 1.98* | 0.95 |
| - | 43.91 | 42.33 | - | 1.57* | 0.95 |
| - | 43.91 | - | 43.96 | 0.06 | 0.95 |
| - | - | 42.33 | 43.96 | 1.63* | 0.95 |

**Table V:** Computation of analysis of covariance on bone mineral density

| Test | AEFSTG | DSG | AEFST & DSG | CG | Source of Variance | Sum of squares | df | Mean Squares | F- ratio |
|---|---|---|---|---|---|---|---|---|---|
| Pre Test Means | 1.04 | 1.07 | 1.03 | 1.03 | BG | 0.01 | 3 | 0.004 | 1.04 |
| | | | | | WG | 0.14 | 36 | 0.004 | |
| Post-test Means | 1.09 | 1.12 | 1.10 | 1.01 | BG | 0.07 | 3 | 0.023 | **7.47*** |
| | | | | | WG | 0.11 | 36 | 0.003 | |
| Adjusted Post Means | 1.09 | 1.10 | 1.11 | 1.02 | BG | 0.05 | 3 | 0.019 | **11.67*** |
| | | | | | WG | 0.06 | 35 | 0.002 | |

Table V shows that the obtained F value on pre test scores on Bone mineral density was 1.04 lesser than the required value of 2.87 to be significant at 0.05 level. The obtained post-test F value of 7.47 was greater than the required F value of 2.87. Further, the obtained adjusted post-test F value of 11.67 was greater than the required F value of 2.87. The results presented in Table IV, there was no significant difference between the experimental groups at 0.05 level of confidence with the confidence interval value of 0.06. It was concluded that the combined Aerobic exercise with functional strength training and Dietary supplementation produced greater changes in bone mineral density.

**Table VI:** Scheffe's post hoc test on lean body mass (Scores in Kg)

| Adjusted Post- test Means | | | | Mean Difference | Confidence Interval value |
|---|---|---|---|---|---|
| CG | AEFSTG | DSG | AEFST & DSG | | |
| 1.02 | 1.09 | - | - | 0.07* | 0.05 |
| 1.02 | - | 1.10 | - | 0.08* | 0.05 |
| 1.02 | - | - | 1.11 | 0.10* | 0.05 |
| - | 1.09 | 1.10 | - | 0.01 | 0.05 |
| - | 1.09 | - | 1.11 | 0.03 | 0.05 |
| - | - | 1.10 | 1.11 | 0.02 | 0.05 |

## Conclusion

The results clearly confirmed that from the current study notorious that the changes over time in the majority of the body composition variables due to the aerobic exercise with functional training and dietary calcium supplementation. Treatment altered the distribution Fat Mass, Lean mass and Bone mineral density among the men with osteopenia (Nguyen, Center & Eisman, 2000).

In summary, this study demonstrated that the effects of aerobic exercise with functional strength training and calcium supplementation on bone mineral density in osteopenia patients can be increased by the adoption of a training and diet supplementation. Adequate dietary calcium intake, in later period of life could possibly translate into a reduction in the risk of osteoporosis and hence improve the quality and quantity of life in the elderly population.

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