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The Impact of a Proposed Exercise Program and Dietary Supplement on the Physiological Health of Osteoporotic Women

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ABSTRACT

Osteoporosis is the most common of all bone diseases in adults, especially in old age, it results from diminished organic bone matrix, and the osteoplastic activity in the bone usually is less than normal and the rate of bone deposition is depressed. The object of the study is to assess the impact of a proposed exercise program and dietary supplement on the physiological health of osteoporotic women. This study included 20 healthy women as control group (1) mean age 50.2 ± 6.67 years, 20 osteoporotic patients as experimental group (2) mean age 51.3 ± 6.73 years. The experimental group was subjected to proposal training program for 2 months, composed of strength intensity low to moderate, frequency three timed per week in conjunction with cardio vascular program, duration: total 60 minutes warm up(10min.) 20min. cardio, 20min resistance training, 10min. cooling down. The experimental group administrated 3 tablets of dietary supplement contains shellfish (shrimp, crab, lobster, crayfish) at sedentary lifestyle. Bone density measurement (BMD) in lumbar vertebrae and in narrow neck of femur adjoining the hip bone was performed by DEXA method, BMI and body composition determined by Tanita device, calcium and VitD assess pre-post experiment of all participants. Results indicated a positive (BMD in osteoporotic women, calcium, VitD at end of training and dietary supplement together with a decreased BMI and body composition variables. The results of the osteoporotic women improvement did not reach result of the control women. In conclusion: the proposed training program together with the dietary supplement induced a positive results and need more duration period for exercise and supplement and it could be a therapeutic inroad in the fight against osteoporosis.

***Keywords*:** Osteoporosis, exercise program, dietary supplement, physiological health, DEXA.

Introduction

Osteoporosis is a serious disease that induces health and economic problems in developed and underdeveloped countries. It is caused by relative excess of osteoclast function, loss of bone matrix is marked and incidence of fracture is increased. Fractures are common in the distal forearm vertebral body and hip, the areas that have a high content of trabecular bone (Khaltaev, 1996 and Larsen, 2003). Adult women have less bone mass that adult man, after menopause they initially lose it more rapidly than men. The cause of bone loss after menopause is primarily estrogen deficiency as it inhibit secretion of cytokines (IL1, IL6) and tumor necrosis factor (TNF-α) (Rosen, 1996).

Inactivity or being sedentary can be hazardous to the health, and may lead to many diseases, developing diabetes, cancers, high blood pressure and bone diseases. And changes associated with both aging and inactivity include changes in muscles, bones, brain, cholesterol, blood pressure, sleep habits, sexual performance, psychological inventory. But how to prevent these changes, by proper exercise that fit to the age. There are some guidelines that can help specially old women to prolong their independence: by engaging too low to moderate intensity exercise, with a greater number of repetitions, as for frequency must be 2-3 times per week in conjunction with cardio program, and 60 minutes of duration, (warm up 10min, 20min cardio, 20min resistance training, 10min cooling down) (Hatfield, 2013; Guyton and Hall, 2000).

Dietary supplementation are part of the integrated nutrition on approach, of maintain proper health, physical and mental performance supplementation may be used for different reasons: to lose fat, to get stronger, to build muscle mass, to reduce pain or inflammation, for tissue healing, for general health or bone health specially for post-menopausal women. Bone health needs Mineral and Vitamins, specially speaking calcium and VitD and sunlight as a preventive measure or therapeutic method. VitD can be obtained from dietary consumption or through de nova synthesis from cholesterol. Cholesterol

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exposure to ultraviolet light in the epidermis form precursor of VitD in the liver to generate (25 OHD), in the kidney is transformed to active VitD (1,25(OH)2 D, 1,25 dihydroxy VitD D3(Barrett *et al.,* 2013). The genes play an important role in affecting calcium homeostasis and bone function, most important gene in this respect is Vitamin D receptor (VDR) as it is expressed in calcium regulating tissues as skeleton, intestine and parathyroid gland in ovary and testis (Stumpf, 1995), the biologically active form exerts its biological activities through genomic and non-genomic responses.

Genomic responses generated by gene transcription through binding with VitD receptors, non-genomic responses include a variety of signal transduction pathways at or near the plasma membrane (Mizwicki *et al.,* 2010; Haussler *et al.,* 2011).

The object of the study is to assess the impact of a proposed exercise program and dietary supplement on the physiological health of osteoporotic women.

2. Subjects and Methods

The study included 20 healthy women as control group mean age 50.2 ± 6.67 years, 20 osteoporotic women as experimental group (2), mean age 51.3 ± 6.73 years.

All subjects were female to avoid the effect of sex on some of the parameters to be investigated.

2.2. Blood sample:

5ml blood was extracted from the ante-cubital vein, were placed into clean dry test tubes, allowed to clot at room temperature, sera were separated and kept frozen at-20^{O}c until used for estimation of calcium and VitD. (Calcium was assayed using atomic absorption spectrophotometer. 25OH was determined using Elisa technique.

Bone mass measurement (BMD) in g/cm2 of lumbar vertebrae and in narrow neck of femur adjoining the hip bone was performed by DEXA method (Dual Energy X-ray Absorption) in specialized center.

Also body composition was performed using Tanita device for body fat measurement and lean body mass.

Weight was determined, height was measured, and body mass index was calculated according to Gray (1989):

Body mass index = body weight in Kg (height in meters)^2

2.3. Waist circumference measurements

Locate the upper hipbone and top of the iliac crest. Place the measuring tape in a horizontal plane around the abdomen at level with the iliac crest, make sure that the tape is snug, the skin is not compressed and the tape measure in parallel to the floor (Hatfield, 2013).

The experimental group was subjected to a training program for 2 months, composed of strength intensity low to moderate, frequency three times per week in-conjunction with cardio training.

2.4. Duration of set

Total 60 minutes: 10min warm up, 20min cardio, 20min resistance training, 10min ooling down. (Strauss *et al.,* 2001; Hinderliter *et al.,* 2002).

The experimental group administered 3 tablets of dietary supplement contains shell fish (shrimp, crab, lobster, cray fish) at once with a meal, the control group administered placebo and had a sedentary life style.

All participants were tested pre-post experiment.

2.5. Statistical analysis

All results were expressed as mean ± SE.

Statistical analysis was performed with statistical package for the social science (SPSS), USA.

The statistical significance was evaluated by using student T test for comparison between normal and diseased group, $P<0.05$ was considered to indicate significance.

3. Results

Table 1: Results of densitometry measurements in lumbar vertebrae, BMI values of control and osteoporosis women pre-post experiment

Variables	Control		Osteoporosis	
	Pre	Post	Pre	Post
BMI	25.6 ± 3.8	26.3 ± 5.4	27.3 ± 4.9	26.1 ± 3.2
BMD	1.17	1.18	0.84	1.02
T-Score	-0.3	-0.4	-3.0	-1.5

BMI significantly decreased, with significant increase BMD after experiment of osteoporosis women.

Table 2: Results of densitometry measurements in narrow neck of femur adjoining the hip bone, BMI values of control and osteoporosis women pre-post Exp.

Variables	Control		Osteoporosis	
	Pre	Post	Pre	Post
BMI	27.3 ± 4.5	26.8 ± 5.1	26.4 ± 5.6	25.9 ± 6.1
BMD	1.04	1.042	0.67	0.83
T-Score	+0.3	+0.3	-2.6	-1.5

BMI significantly decreased, with significant increase BMD after experiment of osteoporosis women.

Table 3: Results of densitometry measurements in lumbar vertebrae, BMI values of control and osteoporosis women post experiment.

Variables	Control	Osteoporosis
	M S E	M S E
BMI	26.3 ± 5.4	26.1 ± 3.2
BMD	1.18	1.02
T-Score	-0.4	-1.5

BMD in osteoporotic women is lower than control group.

Table 4: Results of densitometry measurements in narrow neck of femur adjoining the hip bone, BMI values of control and osteoporosis women post Experiment.

Variables	Control	Osteoporosis
	M ±S E	M ± S E
BMI	26.8 ±5.1	25.8± 6.1
BMD	1.042	0.83
T-Score	+0.3	-1.5

BMD in osteoporotic women is lower than control group.

Table 5: Calcium and 25 OHD of control and osteoporotic women pre-post experiment.

Variables	Control		Osteoporosis	
	Pre	Post	Pre	Post
Calcium mg/dl	8.6 ± 0.5	8.9 ± 0.8	7.4 ± 0.7	8.2 ± 0.6
25 OHD mg/ml	30.2 ± 2.4	30.4 ± 2.3	19.8 ± 1.2	26.4 ± 2.5

Post experiment indicated an increased VitD (25 OHD) and calcium level compared to the results before the training program and dietary supplement, this increased level did not reach the values of the control normal group.

Table 6: Calcium and 25 OHD of control and osteoporotic women post experiment.

Variables	Control	Osteoporosis
	M ± SE	M ± SE
Calcium mg/dl	8.9 ± 0.8	8.2 ± 0.6
25 OHD mg/ml	30.4 ± 2.3	26.4 ± 2.5

In osteoporotic women experiment Ca+ and VitD shows a significant decreased compared to control group.

Table 7: Body composition measurements of control and osteoporotic women pre-post experiment.

Variables	Control		Osteoporosis	
	Pre	Post	Pre	Post
Essential fat %	15 ± 0.7	16 ± 1.2	17 ± 0.8	15 ± 0.9
Storage fat %	18 ± 1.1	19 ± 1.3	27 ± 1.6	19 ± 1.4
Lean body Mass %	67 ± 8.9	65 ± 8.3	62 ± 5.9	66 ± 4.7
Waist circumference (cm)	86 ± 6.4	85 ± 5.9	89 ± 6.7	84 ± 5.4

Essential fat %, storage fat % shows a significant decrease % post experiment in osteoporotic women while in control group non-significant change as for lean body Mass. Shows a significant increase % post experiment in osteoporotic women, while in control group non-significant change. Waist circumference decreased significantly post experiment of osteoporotic women, while non-significant change in control group.

Table 8: Body composition measurements of control and osteoporotic women post experiment.

Variables	Control	Osteoporosis
	M ±SE	M ± SE
Essential fat %	16 ± 1.2	15 ± 0.9
Storage fat %	19 ± 1.3	19 ± 1.4
Lean body Mass %	65 ± 8.3	66 ± 4.7
Waist circumference (cm)	85 ± 5.9	84 ± 54

Data of body composition variables show non-significant changes between control and osteoporotic women post experiment.

4. Discussion

Table(1,2) the results of densitometry measurements in lumbar vertebrae and in narrow neck of femur adjoining the hip bone in osteoporotic women indicated an improvement following training program and dietary supplement, which revealed the positive effect of training and supplementation on bone density and deposition of calcium following treatments.

Researchers confirm the positive effect of training and convenient supplementation on improvement of bone density (Brooke *et al.,* 1997, Rosen, 1996, Rosen, 2003). Rosen (2003) also added that some hormone may induce improvement of bone density such as estren and parathyroid hormone and insulin growth factor (1) (IGF (1).

Studies shows that BMD assessment on femur and vertebrae, can predict fracture risks, and that the gold standard for BMD assess, is DEXA, that uses the X-Ray in very small amount, the diagnosis for cases of osteoporotic, when we found that, density in the femur, vertebrae or wrist as example lesser that the mean value of normal female, of standard deviation 2,5 or more that the mean value (Tenenhouse *et al.,* 2000).

This was also reported in the study data (Snow *et al.,* 1996) added that DEXA can predict osteoporotic and the possibility of fracture in next years, this may be beneficial because new medications can help in these situations, in the same line training and dietary supplement may improve the cases. Also the danger of bone fracture increased with age, and may double in age of sixty.

Table(5,6) indicated that post experiment shows an increased VitD (25 OHD) and calcium level compared to the results pre the training program and dietary supplement for two months, this increased level did not reach the levels of the control normal group. The results are in accordance with Larsen and Meyer (2015) and Fishman *et al.,* (2016) also reported that VitD assay less than 20 mg/ml is defined as deficient; the levels between 21-29 mg are defined as insufficient, while more than 30 mg/ml are defined as sufficient.

Haiam (2012) added that Vit D is highly regulated steroid hormone system, and VitD3 is present in food of animal origin such as fish liver oil and shell fish as shrimp, crab, lobster and crayfish, egg yolk, milk and others, and the classical effect of VitD include the action on bone to maintain calcium homeostasis and bone density.

Researchers reported that calcium level decreased in case of VitD deficiency, renal insufficiency, hyperparathyroidism, hypo-protein and severe pancreatitis and increased in VitD excess and hyperparathyroidism and osteoporotic disease (Girgis *et al.,* 2013; Murrey *et al.,* 2006).

Table (7, 8) body composition measurement shows a significant decreased essential fat % storage fat % together with waist circumference of osteoporotic women post training program plus dietary supplement while lean body mass % significantly increased, and in case of control group the data indicated non-significant change, also there was non-significant change between the osteoporotic women and the control group in case of comparison of post experiment in the different variables.

The results indicated that the training program plus the dietary supplement improved body composition and waist circumference due to increased calories output which in turn decreased fat % while maintaining lean body mass.

This result is in accordance with that of Bravo *et al.,* (1996) and Heinonen *et al.,* (1996). Total body fat is deposited in the body and is divided as essential fat and storage fat, and essential fat is required for normal physiological functioning is stored in different organs as heart and lung, and in female additional essential fat in the mammary glands and pelvic region. The reserve fat protect the various organs of the body. It is of importance to say that Body Mass Index (BMI) if often used as a predictor of future disease risk and evaluating abdominal fat through waist circumference measurements is important in determining health risk this is in accordance with American College of Sports Medicine (1992, 1993).

Results shows that BMI and waist circumference measurements significantly decreased post training program plus supplementation with dietary tablets, which indicated that the osteoporotic women benefit from the intervention and the improvement was for the sake of health and fitness due to the increased health risk factors.

Kelly and Tran (2004) reported that both BMI and waist circumference measurement are important methods for prediction of future health risk as it is misleading to measure weight only, because weight scale do not assess the proportion of fat to lean body mass. It is important to assess body composition to compare the fat % compared to weight as an indication of proper health.

Osteoporosis has different causes the most common one is involution osteoporosis. Early in life during growth, all humans gain bone, and after a plateau, they begins to lose bone in elderly. When this loss is accelerated it leads to the disease.

Which is more common in females than in males, especially after menopause, due to estrogen deficiency (Barret *et al.,* 2010). Intake of calcium from natural sources such as milk products and fishes, together with VitD, sunlight and moderate exercise may help prevent or slow the progress of osteoporosis. Also bisphosphonates such as etidronate, which inhibits osteoclasts making bone more dense. (Chatterjea and Shinde, 2006).

Kreider *et al.,* (2002) and Macdonald (2000) reported that linoleic acid supplementation plus resistance training induced an improvement on body composition, bone density, strength and selected hematological markers, they also added that the supplementation using linoleic acid may play an important role in fighting osteoporosis while improving the immune system.

5. Conclusion

The present study confirmed the presence of alterations in bone density and calcium, VitD together with body composition in osteoporotic women. These alterations were improved by a proposed exercise program and suitable dietary supplement which need more duration period for inducing better results and it could be a therapeutic in road in the fight against osteoporosis.

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