The Role of Resistant Training on Bone health of Female Students in 100, meters run

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Abstract: Exercise as a potential factor in the prevention of osteoporosis has attracted interest in recent years. The significant effect of the level of physical activity on muscle strength and the bone mineral density has been demonstrated. But, Exercise as a prophylactic intervention has not been investigated extensively. The aim of this study was to assess the role of resistant training on bone density of female students in 100, 200 meters run. **Materials and Methods:** Twenty volunteers of female students (age 18-20y) participants, in 100, meters run were assigned to a resistant training group (n = 10), three times weekly for 12 weeks and a control group (n = 10). The resistance training group performed knee extensors by dynamic leg press, and leg extension exercises increasing from low (20RM) to high (8RM) resistance. The control group did not participate to any training. Hip bone density was measured using DEXA, before and after intervention, leg strength was measured by dynamometer, parathyroid hormone by Elisa, calcium by atomic absorption method, data were analyzed by means of Anova. **Results:** Resistance training improved leg strength tests, and also increased significantly BMD, calcium, parathyroid hormone increased significantly P > 0.05. **Conclusion:** These findings suggest that Resistant training may be effective in retardation osteoporosis and modify risk factors.

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Key words: Resistant training, Bone mineral density, calcium, parathyroid hormone.

1. Introduction:

Osteoporosis is a serious condition. The fractures that follow in its wake cause immense suffering and disability and are frequently the initial event on the road that leads to residential nursing care. The financial burden of treating osteoporotic burden and its consequences is vast. It is not surprising therefore that clinical interventions to prevent and treat osteoporosis are the subject of close scrutiny ***(Chris Barclay 2003).***

In human, parathyroid hormone and possibly calcitonin are known regulators of calcium homeostasis, and their imbalance can contribute to bone loss. Hormonal changes can be associated with an increased incidence of osteoporosis. Parathyroid hormone increases the serum calcium level through increases in bone resorption by stimulating osteoclastic activity and bone remodeling ***(Eriksen et al., 1988)***.

Carroll et al., (2001) reported that effects of resistance training on neuromuscular proportion of skeletal muscles through not only intra muscular fraction but also by the extent of neural activation, allow better coordination of the activation of the relevant muscles, resulting in a greater force in intended direction of movement and bone strength.

The potential contribution of load bearing exercise to preserve bone density and prevent osteoporosis has received some attention. In this regard, a relatively vigorous strength training regimen has been shown to be most effective ***(Gutin and Kasper, 1992).***

The problem is that a higher percent of young females are subjected to osteoporosis and injuries due athletic performance which led to this study.

The aim of this study was therefore to assess the role of resistant training on bone density of female participants in 100, 200 meters run.

Hypothesis of the research:

- There are significant differences between pre and post resistant training in isotonic leg muscle strength for the sake of post training.
- There are significant differences between pre and post training in Hip BMD for the sake of post training.
- There are significant differences between pre and post training in calcium and parathyroid hormone for the sake of post training.

2. Materials and Methods

Subjects and study design twenty volunteers of female students (1st year) in Physical Education faculty, El Gezera, Helwan University, participants in 100, meters run, they were assigned to a resistant training group I (n = 10) three times weekly for 12 weeks and a control group II (n = 10). Aged (18-20 years), free from diseases or medications known to affect bone metabolism or muscle strength. All subjects were randomly assigned to the study. 10 students were trained for 3 months to a resistant training, performed knee extension by dynamic knee press, and single leg extension exercises increasing from low (20 RM) to high (8 RM) resistance. The control group did not participate to any training. Hip bone was measured using DEXA, before and after intervention, leg strength was measured by dynamometer, parathyroid hormone by Elisa, and calcium concentration by atomic absorption method.

Research methods:

Procedures:

The researcher used the experimental design with two groups, one experimental and the other control group.

Tools and equipment used:

- Balance scale.
- Restameter.
- Syringes.
- Special tubes.
- Cotton and spirit, plaster.
- DEXA apparatus for bone mineral density.
- Elisa for parathyroid hormone.
- Atomic absorption for calcium measurements.
- Centrifuge for blood separation.
- Box and ice.
- Dynamometer for strength leg measure.

Training program:

Consisted of unilateral (single leg) training of the dominant leg three times per week. Training was performed on leg extension machine for resistance. The untrained leg was kept in a relaxed position throughout the training program. Subjects would warm up on a bicycle ergometer for 3 minute before each training session. Subjects performed stretching of the knee extensors and hip flexors after each training session. All procedure of the program was after ***Kostek et al., (2005).***

Osteoporosis can be reliably identified by bone densiometry. The availability of Dexa scanning machines is still patchy in Egypt. However bone densiometry remains the gold standard in the measurement of osteoperosis and response to therapy.

In the absence of such investigative machines, patients need to be managed on a clinical basis ***(Gennari, 2002).***

Table (1): Baseline characteristics of resistant training and control (n = 20):

Characteristics	*Resistance Training (n = 10)*	*Control(n = 10)*	*Significant*
Age (year)	19.1 ± 1.3	18.9 ± 1.1	NS
Weight (kg)	61.2 ± 6.4	63.1 ± 5.4	NS
Height (cm)	1.59 ± 0.4	1.62 ± 0.6	NS
BMI (Kg/m^2)	20 ± 2.1	21.0 ± 1.9	NS

$P < 0.05$

All training procedures were done in the special Gym,

<u>Statistical analysis</u>:

T test was used to test the differences among resistant training and control groups.

Level of significance was set at $P < 0.05$.

3. Results:

Table (1) revealed a non significant differences observed at baseline between resistant training (n = 10) and control (n = 10) groups in age, weight, height and BMI, significant level at $p < 0.05$.

Table (2) revealed that hip bone mineral density (BMD) increased after resistant training compared with control group.

Also isotonic leg muscle strength (K) increased significantly in resistant training group after training compared to control group.

As for parathyroid hormone concentration and calcium concentration. There was significant increase in case of resistant training groups compared to control group.

Table (2): Isotonic strength, Hip BMD, Parathyroid H. and calcium conc. at rest and after the training program No. 10

Variable	*Experimental Group*		*Control Group*	
	Before	*After*	*Before*	*After*
Isotonic leg muscle strength (K)	80.1 ± 9.9	86.1 ± 10.2*	81.2 ± 12	82.4 ± 11
Hip BMD(g/cm^2)	0.84 ± 0.1	0.86 ± 0.03*	0.82 ± 0.09	0.83 ± 0.12
Parathyroid H (mg/ml)	25.2 ± 1.8	30.1 ± 1.6*	23 ± 3.6	23.4 ± 4.5
Calcium(mg/dl)	8.3 ± 1.1	9.4 ± 1.2*	8.4 ± 1.3	8.5 ± 1.1

The level of significant $P < 0.05$

Table (3): Isotonic strength, Hip BMD, Parathyroid H, and calcium conc. after the training program. n = 10

Parameters	***Experimental Group***	***Control Group***	***Sig.***
Isotonic leg muscle strength (K)	86.1 ± 10.2	82.4 ± 11	S
Hip BMD(g/cm^2)	0.86 ± 0.03	0.83 ± 0.12	S
Parathyroid H (mg/ml)	30.1 ± 1.6	23.4 ± 4.5	S
Calcium(mg/dl)	9.4 ± 1.2	8.5 ± 1.3	S

Sig. Level $P < 0.05$.

4. Discussion:

Prevention is said to be better than cure and there are now a number of treatments available for osteoporosis. There are several risk factors for osteoporosis: Early menopause, hysterectomy, long-term steroid use, Mal absorption disorder, lean body habitus, strong family history, cigarette smoking, previous primary event (fragility facture) ***(Vashisht et al., 2000).***

The data presented in Table (2, 3) indicated an increased bone mineral density, after 3 months of resistant training. These results are in accordance with ***Barclay (2000), Fraughnan (2001), Ettinger et al., (1999), Kanis (2000). Sinaki (1989)*** suggested that physical activity, when started early in life, results in high bone mineral content and increased dimensions of bone ***(Torvinen et al., 2002). Body (2002)*** reported that calcitonin administration can be helpful for the long term prevention and treatment of osteoporosis.

Carroll et al., (2001) reported that effects of resistant training on neuromuscular proportion of skeletal muscles through intramuscular fraction and better coordination resulting in a greater force in movement and bone strength. Also recorded by ***Jeff and Barbara Galloway (2012) and Roshdi (2010).***

Muscle strength (Table 2, 3) were significantly higher in case of resistant training compared to control. This increased muscle strength might be due to the positive action of the resistant training leading to an increased effect of growth factors, IGF, b-FGF ***(Menan, 2011), Sabive et al., (2004) (Rilin et al., 2002).***

Runge et al., (2000) reported that tonic vibration reflex is able to cause an increase in recruitment of the motor units through activation of muscle spindles and polysynaptic pathways.

Parathyroid hormone and calcium concentration (Table 2, 3), revealed an increased concentration after 12 weeks of resistant training compared to control. These results were in accordance with those of ***Silver et al., (1998) and Marks et al., (1996). Hunter et al., (2001)*** reported genetic influence on hormones regulating bone metabolism and calcium homeostasis, they also added that the genetic regulation of parathyroid hormone synthesis and the large genetic influence on Vit. D metabolites and their findings protein suggest the possibility of novel therapeutics therapy.

Barrett et al., (2010), El Ashkar (2013) reported that calcium is an essential intracellular signaling molecule and also plays a variety of extracellular functions, thus the control of bodily calcium concentrations is vitally important. They also added that parathyroid hormone is secreted by the parathyroid glands, its main action is to mobilize calcium from bone and increase urinary phosphate excretion, and many of the systems that regulate calcium homeostasis also contribute to that of phosphate. Parathyroid increases the formation of dihydroxycholecalciferol, and this increases calcium absorption from the intestine. On a longer time parathyroid stimulate osteoblast ***(Rubin et al., 1995)***.

Kostek et al., (2005) reported that muscle strength decline at the rate of 12-24% per decade, the loss of muscle mass is related to a loss of functional abilities, dependency, decreased bone mineral density which has negative consequences for the health status, They also added that resistance training affect positively muscle strength through action of $IGF_{(1)}$ insulin growth factor "1" which have been shown to increase muscle mass and possibly strength.

Through the discussion, it may be showed that the three hypothesis of the study has been realized.

Conclusion:

It may be concluded that the resistant training may be effective in osteoporosis prevention and may modify risk factors in older women, due to its effect on bone mineral density and calcium and parathyroid functions.

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