

**Effect of Aerobic Exercise, Vitamin K and D  
on Bone Metabolism in Ovariectomized Adult  
Rats.**

THESIS

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## SUMMARY

In the present study the effect of exercise training, vitamin D3 and vitamin K1 alone or in combinations on ovariectomized rats was tested aiming to detect the best combination that prevent osteoporosis in ovariectomized rats

In the present study, treadmill exercise protocol was performed on motorized electric treadmill for 9 weeks (for 63 successive days). Running on the treadmill began for 5 minutes/day and then increased till it reached 30 minute /day after 2 weeks and continued with the same duration for the following 7 weeks.

Vitamin D3 was given to rats in the form of one alpha hydroxy cholecalciferol 1ug and was administered at a dose of 0.1 µg/kg body weight daily given by oral gavage.

Vitamin K1 (phytomenadione) was given in a dose of 0.0009 mg/g body weight daily given by oral gavage.

The present study was performed on eighty adult female albino rats; that were subjected to ovariectomy then were classified into two equal main groups.

### **Group I Sedentary group (n=40):**

Rats were put on the treadmill without running.

This group was further subdivided into 4 subgroups a, b, c and d:

- **Subgroup Ia (n=10):** They didn't receive any vitamin.

- **Subgroup Ib (n=10):** They received vitamin D3 supplementation daily by gavage.
- **Subgroup Ic (n=10):** They received vitamin K1 supplementation daily by gavage.
- **Subgroup Id (n=10):** They received both vitamin D3 and vitamin K1 supplementation daily by gavage.

**Group II Exercise group (n=40):**

Rats performed treadmill exercise according to the planned programme.

This group was further subdivided into 4 subgroups a, b, c and d:

- **Subgroup IIa (n=10):** They didn't receive any vitamin, they received only water by gavage simultaneous with treadmill exercise.
- **Subgroup IIb (n=10):** They received 0.1µg/kg body weight of vitamin D3 supplementation daily by gavage simultaneous with treadmill exercise.
- **Subgroup IIc (n=10):** They received 0.9 mg/Kg body weight of vitamin K1 supplementation daily by gavage simultaneous with treadmill exercise.
- **Subgroup IId (n=10):** They received both vitamin D3 and vitamin K1 supplementation daily by gavage simultaneous with treadmill exercise.

At the end of the experiment (on the 64th day, 9 weeks) blood samples were collected from the retro-orbital sinus under light ether inhalation anesthesia. Then, rats were sacrificed by cervical dislocation. Right tibias were dissected and prepared for histological examination.

At the end of experiment all groups were subjected to:

**1) Estimation of Biochemical Markers of Bone Metabolism:**

**a. Bone formation markers:**

- i. Serum Osteocalcin (Oc).
- ii. Serum Bone specific alkaline phosphatase (BSAP).

**b. Bone resorption markers:**

- i. Serum Undercarboxylated osteocalcin (UnOc).
- ii. Serum Tartrate resistant acid phosphatase isoenzyme 5b (TRAP5b).

**2) Histological examination: of tibial metaphysis to determine osteoporotic changes.**

**The results of the following study are summarized in the following:**

Exercise training in ovariectomized adult rats induces moderate increase in bone formation as indicated by significant increase in Osteocalcin and induces a marked decrease in bone resorption as indicated by significant decrease in Undercarboxylated Osteocalcin. Histological examination confirmed these results.

Vitamin D3 supplementation in ovariectomized adult rats induces moderate decrease in bone resorption as indicated by significant decrease in Tartrate Resistant Acid Phosphatase. Histological examination confirmed the moderate decrease in bone resorption and revealed an additional moderate increase in bone formation that was not obvious in Biochemical markers of bone turnover, suggesting that changes in bone histology may precede serum changes of bone marker level.

Vitamin K1 supplementation in ovariectomized adult rats induces marked decrease in bone resorption as indicated by significant decrease in Undercarboxylated Osteocalcin and Tartrate Resistant Acid Phosphatase. Histological examination confirmed the marked decrease in bone resorption and revealed an additional moderate increase in bone formation that was not obvious in serum Biochemical markers of bone turnover.

Combined vitamin D3 and vitamin K1 supplementation in ovariectomized adult rats induces marked decrease in bone resorption as indicated by significant decrease in Undercarboxylated Osteocalcin and Tartrate Resistant Acid Phosphatase, as well as a synergistic effect on bone formation as indicated by significant increase in Bone Specific Alkaline Phosphatase. Histological examination confirmed these results.

Combined exercise training with vitamin D3 supplementation in ovariectomized adult rats induces a marked increase in bone formation as indicated by significant increase in Osteocalcin and Bone Specific Alkaline Phosphatase and a marked decrease in bone resorption as indicated by significant decrease in Undercarboxylated Osteocalcin and Tartrate Resistant Acid Phosphatase. Histological examination confirmed these results.

Combined exercise training with vitamin K1 supplementation in ovariectomized adult rats induces moderate increase in bone formation as indicated by significant increase in Bone Specific Alkaline Phosphatase while this combination insignificantly change Osteocalcin that was significantly increased with exercise alone. On the other hand, this combination induces marked decrease in bone resorption as indicated by significant decrease in Undercarboxylated

Osteocalcin and Tartrate Resistant Acid Phosphatase. Histological examination confirmed these results.

Combined exercise training with vitamin D3 and vitamin K1 supplementation in ovariectomized adult rats induces marked increase in bone formation as indicated by significant increase in Osteocalcin and Bone Specific Alkaline Phosphatase and a marked decrease in bone resorption as indicated by significant decrease in Undercarboxylated Osteocalcin and Tartrate Resistant Acid Phosphatase. Histological examination confirmed these results.

Studies that compare the effect of the best effect encountered in our study (combined exercise, vitamin D and vitamin K) with hormone replacement therapy and other standard treatments.