THE RISK OF OSTEOPOROSIS IN MILITARY WOMEN EXPOSED TO CHRONIC OCCUPATIONAL STRESS

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Stress fractures have a significant impact on military personnel, limiting the freedom of movement and increasing costs of treatment and recovery. The aim is to determine the risk of osteoporosis in military women exposed to chronic occupational stress. Materials and methods: 31 employees of military female, apparently healthy, without previous osteoporotic therapy were divided into 3 groups according to the body mass index (BMI). Lumbar bone mineral density was evaluated by dual X ray absorptiometry (DXA), while serum leptin was evaluated by ELISA. Results:High chronic stress is associated in literature with high levels of leptin and increased risk of osteoporotic fractures default stress. Conclusions: women in the military subject to significant occupational stress are exposed to a number of factors that may predispose to increased bone fragility.

Keywords: osteoporosis; fracture stress; leptin; military occupational stress.

Stress fractures have a significant impact on military personnel, limiting the freedom of movement and increasing treatment costs and recovery time. The program, Bone Health and Military Medical Readiness", (BHMMR), launched by the U.S. Defense Department estimated costs $ 1,850,000 and the 4120 annual work days lost for military personnel, with a stress fracture incidence of 3.4 to 21% for women in the military (1).

Recent research shows that changes in U.S. Navy physical training programs can increase the capacity of movement in military personnel, delay the onset of stress fractures and reduce the incidence of stress fractures(1).

The occupational stress in the military is significant and is caused by multiple factors physical, biological, psycho-emotional, chemical (2).

Recent studies associate chronic exposure to stress with decreased neuropeptide Y expression in the central nervous system (3). Neuropeptide Y is a regulator of bone homeostasis by inhibiting osteogenic effect of

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transcription promoter ligand receptor activator of nuclear factor kappa-B (RANKL) and by increasing osteoprotegerin (OPG) expression in osteoblasts in the early stages of cell differentiation (3). Decreased neuropeptide Y in occupational stress increases the risk of the osteoporosis. Also, chronic stress is associated with increased levels of leptin (4), which in turn inhibits NPY. The current programs for the management of osteoporotic risk in military women recommend adapted exercise.

Material and methods

Our study is a cross-sectional study on 3 groups of about 8 premenopausal women each: 16 women with normal and underweight BMI(BMI <25 kg/m2), 9 overweight women (BMI between 25-30kg/m2) and 6 obese women (BMI>30-40kg/m2). All women volunteered to participate in this study, and were recruited from the military personnel. An informed consent was signed by all women.

Exclusion criteria were: diabetes mellitus, osteoporosis under treatment, hormone replacement therapy, severe liver or kidney disease, hyperthyroidism, primary hyperparathyroidism, hypogonadism, growth hormone deficiency, Cushing's syndrome, corticotherapy for over a year, anorexia nervosa, malabsorption syndrome, genetic syndromes. A fasting blood sample was collected, centrifuged, and stored in a refrigerator (-30°C) for leptin determinations. Then, all volunteers' height and weight were measured, and subjected to osteodensitometry by dual X-ray absorptiometry (DXA). A certified technician measured bone mineral density (BMD) of the lumbar spine on Hologic DXA. Total fat and lean masses were expressed in grams. Lumbar BMD was expressed in g/cm2, leptin (ng /ml) was determined using commercial ELISA kits (Diagnostic Automation Inc., Calabasas, CA). The results were statistically processed using NCSS 2007 software, simple Pearson correlation, student t test, the correlation being considered significant when $p < 0.05$. Multivariate regression (ANOVA) was used to exclude systematic biases.

The occupational stress was assessed by validated questionnaires, and physical activity was assessed in volunteers with normal weight / overweight and morbid obesity by completing a physical activity questionnaire (GP physical activity questionnaire).

Results

All subjects received questionnaires in order to identify the level of occupational stress, with an average subjective perception of 7.19 ± 1.77 on the whole lot. Military organization by its very nature and specificity generates high levels of stress but most soldiers accept stress as a normal

characteristic of their professional life. Problems arise when its effects exceed individual's resistance or capacity of adaptation. There are multiple stressors involved like multiple tasks, conflicting orders, and interpersonal relations, working conditions with insufficient human, technical and financial resources. Following centralization of physical activity questionnaire we found that all volunteers fell into the category of active people.

We intended a correlation between various body compartments with bone mass. BMI is positively correlated with lumbar BMD T score and Z score. The best correlation was achieved for the Z score, because this parameter excludes the influence of age on bone. Due to heterogenity of the study group we used the Z score, which compares the BMD with average BMD for age.

Different body compartments were correlated with lumbar Z score .Thus, the lumbar Z score correlated with total body weight expressed as BMI (Fig. 1 a) and fat mass (Fig. 1b) on a comparable degree, the correlation Z score –lean tissue mass being significantly stronger (fig. 1c).

Lean mass seems to be the most important predictor of bone mass in Caucasian women.

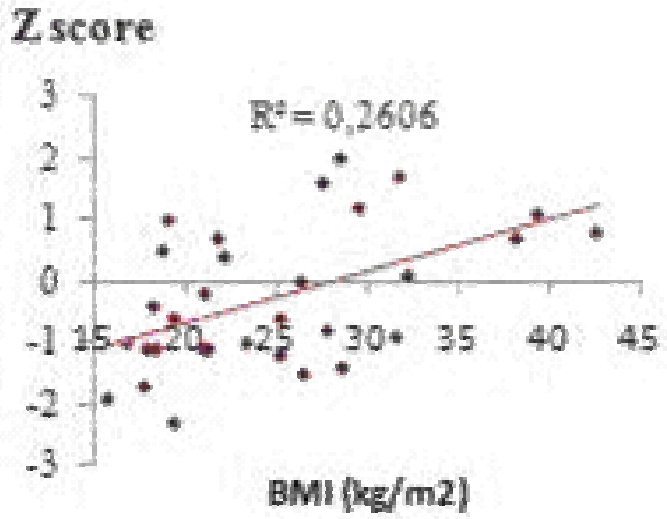

Fig 1a. *Relation between lumbar Z score and BMI*

Correlation is significant R2 0.2606

Between lumbar Z score and fat mass of pre-menopausal women there is also a positive correlation, R2 0 .2414.

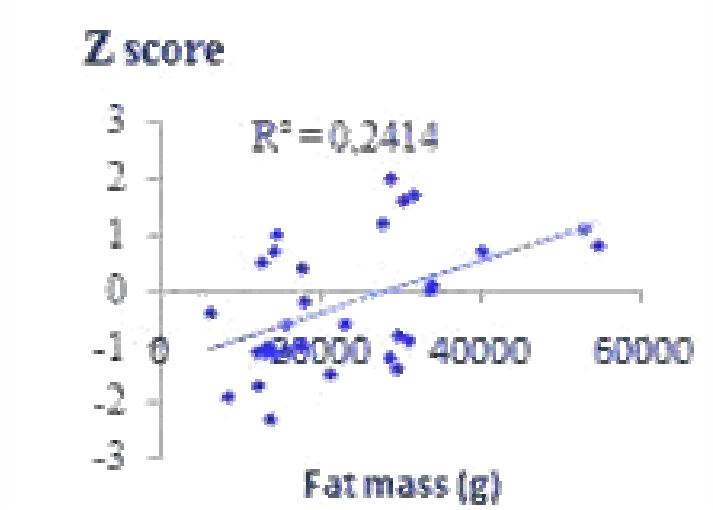

Fig. 1b. *Relation between lumbar Z score and fat mass*

The correlation is positive, but much stronger when it was made between lumbar Z score and lean mass, R2 0.4626.

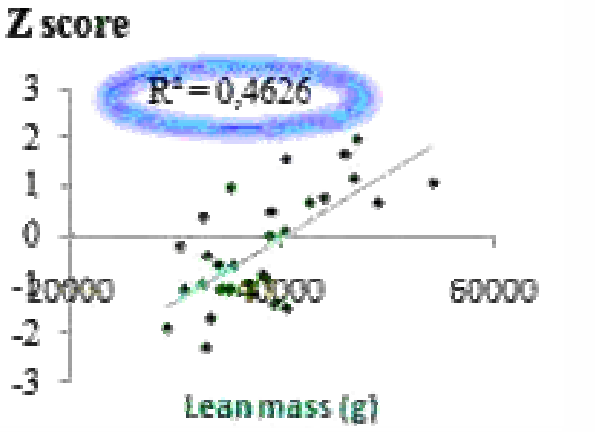

Fig. 1c. *Relation between lumbar Z score and lean mass*

It is known that both leptin and adiponectin are secreted by adipocytes, but only leptin reflects total fat mass. Data concerning the effects of adipose tissue on bone is even more conflicting. Certain authors suggest that fat tissue mass might be more important in predicting bone mass. Other authors described that, once fat tissue mass is expressed as percentage of the total body weight, its predictive effect on bone mass either disappears or becomes negative (5-7).

In our study we established a positive correlation between serum leptin and lumbar Z score and also between leptin and fat mass (Fig. 2).

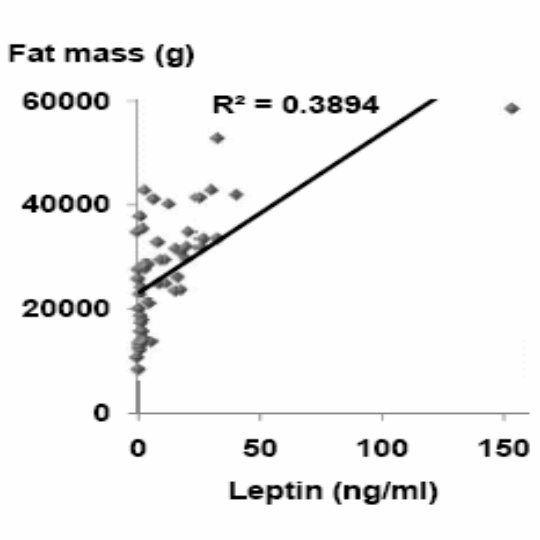

Fig 2 *Relation between leptin and fat mass*

Discussions

Studies in the scientific literature correlate occupational stress exposure with increased levels of leptin, via inhibiting central neuropeptide Y levels and thus possibly promoting the development of osteoporosis.

In our study with relatively young women, apparently healthy, with very strict exclusion criteria, we found a positive correlation of BMD with BMI and also between leptin and BMD. The found results can be explained through increased muscle mass correlated with sustained physical activity .We found normal levels of leptin, but this does not exclude that prolonged exposure to stress, may further increase levels of leptin.

Conclusions

Lean tissue mass has an important predictive role on bone mass, except those who practice intensive sport activity.

Occupational stress level is above average in an area where occupational demands are many and may influence bone mineral density via leptin.

Women in the military being subjected to significant occupational stress and exposed to a number of factors, including diet and calcium deficiency may be predisposed to increased bone fragility and increased fracture risk with significant impact on the ability of movement.

Bone mineral density in military women is affected by various factors and their mechanisms of action are still under research.

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