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Case Report Open Access

The Impact of Body Weight for Bone Mineral Density: A One Year Longitudinal Study in a Young Woman who changed her Lifestyle

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Abstract

A young woman showed a significant decrease in lumbar bone mass after one year of endurance running. She succeeded in running the Boston marathon. In spite of her lifestyle, that was supposed to be beneficial with a high calcium intake (1000 mg/day) and high weight bearing physical activities (7000 MET's/week), she was not able to maintain lumbar bone mineral density (15% decrease). Reasons can be the concomitant 16% decrease in body weight. It is assumed that the weight bearing effect of her lower body weight during the day is an important factor for maintain the bone mineral density in her lumbar spine.

Keywords: Lumbar bone mineral density; Case study young woman; Running intervention; Calcium intake

Introduction

Nienke is a young woman who was involved as a subject in the Amsterdam Growth and Health Longitudinal Study (AGAHLS) Growth, health, fitness and lifestyle of a group of 600 12-14 old boys and girls were measured annually over a period of more than 25 years [1].

Methods

Growth was measured by body weight, body height and body composition by the Sum of 4 Skin folds (S4S), Body Mass Index (BMI), and the percentage fat of body mass (%fat) [2].

Lifestyle was measured by a Physical Activity Questionnaire (PAQ) and her energy intake by a cross-check Dietary History Interview (DHI) [3-6].

In addition we started at age 27 to measure bone mineral density by Dual X ray Absorptiometry (DEXA) in the Lumbar Bone Region (LBMD) [7].

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Subject and lifestyle intervention

One of the female subjects in this longitudinal study was Nienke. She did not smoke, drinking alcohol very moderately and was healthy during the longitudinal study between 13 and 32 years. However, from age 13 years on she always showed a moderate overweight.

Around age 21 she tried to lose body weight by mainly reducing her daily energy intake following a low caloric diet. However she failed in completing this diet.

At age 27 her body height was 169.5 cm and her body weight 73.5 kg, resulting in a BMI of 25.7 (kg/m^2). Her %fat estimated from S4S was 32.5%. These figures indicate a moderate overweight.

Two years later, at age 29 she decided two starts a second try in losing body weight but now aimed on increasing her energy output. She started a one year endurance training by jogging and running. In the beginning she was running twice a week covering 5 km per day, and gradually she increased her training frequency till five times a week covering 10 km per day. Her ultimate goal was to participate in the Boston Marathon (USA).

Results

In this year from the PAQ we estimated an increase of her physical activity pattern from 1000 MET's to 7000 Met's per week. From the DHI it was estimated that her calcium intake was doubled from 500 to 1000 mg/day.

The seven times increase of energy output in combination with a doubling of her calcium intake seem to be an beneficial lifestyle changes to increase the bone mass in the lumbar region.

Their bone mineral density in the lumbar bone region however decreased significantly ($p<0.05$) from 1.15 to 0.98 g/cm^2, indicating a 15% decrease in LBMD. In that year her body weight decreased with 16% from 73.5 kg to 62 kg and her %body fat with 30% to 21% and her BMI with 20% to 21.7kg/m^2.

After this year of endurance training she succeeded to complete the marathon (42.195 m) in four and a half hours. She fulfilled her aim: to lose body weight, body fat and to complete a marathon in 4-5 hours.

Discussion

The one year endurance training of Nienke resulted in a 16% weight loss, but in the same time her bone health was not increased but decreased with 15%. An important reason for that diminished LBMD after one year could be the kind of physical exercise (endurance running) in combination with a decrease of her body weight are not the optimal conditions for increasing the bone mass. The most important stimuli of bone increase are the gravity and mechanical forces from muscles acting on the bones [8].

During endurance running the foot reaction forces acting on the lumbar spine are about two times body weight and can be as a relatively small stimulus for bone mass increase [9].

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The effect of the 16% decrease of body weight must not be undervalued. This lower bodyweight is continuously during most of the day charging a mechanical load on the lumbar vertebrae. Overweightness and obesity play a double role: it increases the risk upon cardiovascular diseases but protects the occurrence of osteoporosis.

Conclusion

As a result of the one year endurance training Nienke lost not only body weight but also bone mass. The latter cannot be explained by a low calcium intake.

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