女性エリートランナーにおけるオーバートレーニングが骨代謝と月経異常に及ぼす影響

財団法人
三菱養和会　永田瑞穂
（共同研究者）東京学芸大学　渡辺雅之
同　有吉正博

Effect of Overtraining on Bone Metabolism and Menstrual Function in Female Elite Runners

by

Mizuho Nagata
The Mitsubishi Yowakai Foundation
Masayuki Watanabe, Masahiro Ariyoshi
Tokyo Gakugei University

ABSTRACT

In recent study it was found that female athletes with exercise-induced amenorrhea accompany low bone mineral density（BMD）at a high incident.

The present study has investigated the effect of overtraining on bone metabolism and menstrual function in female elite runners.

Subjects were 29 students of the university. There were divided into two groups according to training conditions ; 18 college athletes（Training group）;11 physically non-active students（Control group).

Also, the training group were divided into three groups following there kind of exercise ; the long distance group（L group), the sprinter group（S group), and the thrower group（TH groups). Calcaneal bone mass was measured by using ultrasound bone densitometer（A-1000 ,

Lunar Co.).

Stiffness which was calculated from both the speed of sound（SOS）and broadband ultrasound attenuation（BUA). It was used as the diagnostic criterion for measurement of bone strength.

In addition we investigated the bone metabolism in urinary pyridinoline（Pyr）and deoxypyridinoline（D-Pyr）as a marker of bone resorption, in plasma bone alkaline phosphatase（B-ALP）and bone Glaprotein（BGP）as a marker of bone integration.

The results obtained were as follows :

1）The average value of stiffness for control group, L, S and TH groups were 82.1 ± 10.4 , 95.8 ± 11.9, 106.5 ± 10.0 and 114.2 ± 16.0, respectively. There were significant differences against the control group.

2）In the training group the average value of stiffness in normal menstruation group and the exercise-induced amenorrhea group were 103.1 ± 16.1 and 106.0 ± 12.73, respectively , but there were no significant differences among groups.

3）In the training group the average value of %fat in normal menstruation group and the exercise-induced amenorrhea group were 21.9 ± 3.6 and 18.3 ± 1.9, respectively. There were significant differences between groups.

4）In the training group the average value of bone metabolic marker and serum estradiol（E_2）in both normal menstruation group , the exercise-induced amenorrhea group showed no significant differences between groups.

The above results suggest that calcaneal bone mass loss combined with loss of body weight, body fatness and exercise-induced decrease serum estradiol concentration.

Although the measurement of stiffness , urinary Pyr and D-Pyr might be useful for evaluation of bone loss in athletes. The further prospective study is needed.

要　旨

女性の競技選手，とくにマラソンや長距離種目を専門とする選手では骨密度が低いとの報告がなされている．今回，骨量に及ぼすトレーニングの影響を検討するために超音波骨量測定装置を用いて，右踵骨の超音波伝播速度（speed of sound ；SOS），広帯域超音波減衰係数（broadband ultrasound attenuation ；BUA ）およびこの両者から算出される超音波指標であるStiffness index（Stiffness）の測定を行った．また，骨代謝状態を把握するために骨吸収および骨形成マーカーの測定を行った．

今回の結果では非運動群と比較して，運動群のStiffnessおよびSOSが有意に高いことを認めた．また，月経異常を呈する者において，正常な月経周期を呈する者と比べて骨量および骨代謝マーカーに差はみられなかった．このことは，エストラジオールの分泌が1名を除き確認されたことから，月経異常による骨量低下を招くトレーニング量まで到達していない可能性が考えられ，運動性無月経の症状によっては無月経による影響を相殺して骨量維持に効果を及ぼしている可能性が示唆された．また，エストラジオールが検出不可能な

10pg/ml 以下であった 1 名の被験者については，第　度無月経であることが推察され，体脂肪率も 15.1％と低値であり，無月経に体脂肪率の減少が伴うことで，骨量の低下を招いたと推察される．