Regional body composition & muscular strength in female endurance athletes with low and normal radius bone mineral density: preliminary findings

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Introduction
Skeletal muscle mass has been implicated as an important determinant of bone adaptation to exercise through muscle contraction forces acting directly or indirectly on the skeleton (Burr, 1997). Lean tissue mass correlates with IGF-I and it has also been suggested that IGF-I may mediate the muscle – bone interaction (Snow et al, 2000). However it remains unclear if low muscular strength and lean tissue mass represent significant risk factors for osteopenia in female endurance athletes. The purpose of this study was to compare the regional body composition (including lean tissue mass) and muscular strength in two groups of British female endurance athletes; a low ultra distal radius bone mineral density group (Low Radius BMD; t score ≤ - 1.0; n = 8) and a group with normal ultra distal radius bone mineral density (Normal Radius BMD; t score > - 1.0; n = 6).

Methods
Each athlete was measured for height and weight before dual energy x-ray absorptiometry (DXA; GE Healthcare Lunar, Madison, WI, US) was used to determine bone mineral density (BMD) at the following skeletal sites: neck of femur (femur), dominant arm ultra distal radius (radius) and L2-L4 lumbar spine (lumbar). A total body DXA scan was also used to determine total body BMD, bone mass (g), adipose tissue mass (g), lean tissue mass (g) and arm and leg measures of bone mass (g), adipose tissue mass (g), and lean tissue mass (g). For muscular strength, a handheld grip dynamometer was used to establish dominant forearm grip strength and isometric hip extension strength (supine position with 90° of hip flexion) was determined on an isokinetic dynamometer. An independent samples t-test (SPSS Version 11.5) was used to determine differences between the Low and Normal BMD groups and a Pearson product moment correlation was used to determine associations between selected variables.

Results
Preliminary results (mean ± SD) showed that the Low Radius BMD group were weaker for both isometric hip extension and grip strength compared to the Normal Radius BMD group ($P < 0.05$). Total body, femur and lumbar BMD were lower in the Low Radius BMD group compared to the Normal Radius BMD group ($P < 0.05$). Absolute lean tissue mass (g) was greater in the Normal Radius BMD group than the Low Radius BMD group ($P < 0.05$) but when expressed as a percentage of body mass there was no difference between the groups. None of the measures of regional or total body adipose tissue were different between the two groups and none of the measures correlated with bone mass or bone mineral density. Arm lean tissue mass correlated with arm bone mass ($r = 0.94$, $P < 0.05$) and radius BMD ($r = 0.67$, $P < 0.05$). Grip strength correlated with radius BMD ($r = 0.51$, $P < 0.05$) and radius BMD correlated with lumbar BMD ($r = 0.63$, $P < 0.05$).

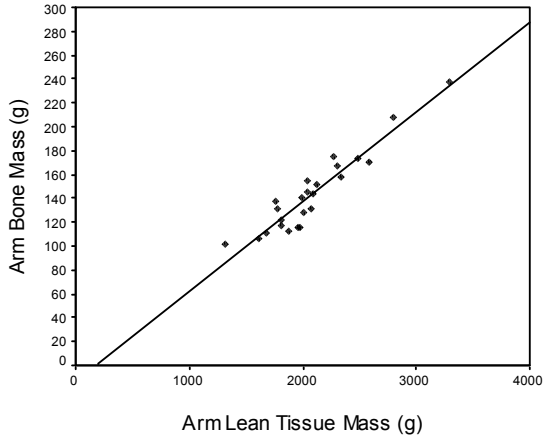

Fig. 1 The relationship between arm lean tissue mass and arm bone mass

Discussion/conclusion
There would appear to be clear differences in the muscular strength, absolute lean tissue mass, bone mass and bone mineral density of the Low and Normal Radius BMD groups for the total body, legs and arms. Lean tissue mass and muscular strength may be predictive of Low bone mineral density in athletes but further studies are required.

References
Burr, D. B.(1997) J. Bone Miner. Res., 12, 1547–1551.
Snow, C. M et al. (2000) Med. Sci. Sports Exerc., 32(11), 1902–1907.