

Quantitative ultrasound of os calcis BMD versus conventional DXA and peripheral QCT in interval assessment of BMD changes in adolescent females



To WWK¹ and M WN Wong²

¹ Department of Obstetrics & Gynaecology, United Christian Hospital

² Department of Orthopaedics & Traumatology, The Chinese University of Hong Kong, Hong Kong

Objective: To compare whether interval BMD changes in adolescent females that can be detected using conventional dual energy X-ray absorptiometry (DXA) of the lumbar spine and hip can also be detected using quantitative peripheral quantitative computerized tomography scans (pQCT) and quantitative ultrasound (QUS) of the os calcis

Methods: Two groups of adolescent females were recruited for assessment of BMD changes over an interval of 22- 24 months. These included full time collegiate dance students from a tertiary performing arts institute and healthy adolescents from an Adolescent Gynaecology clinic. Basic anthropometric measurements, baseline hormonal profile, pelvic ultrasound, bio-impedance body fat estimation, DXA of lumbar spine and hip, pQCT of distal radius and tibia, QUS of os calcis were performed at first assessment, and DXA, pQCT and QUS were repeated at the second interval.

Results: A total of 26 dance students and 14 non-exercising adolescents (mean age 18.6 years, range 16-19) were recruited. The dance students had lower body mass index (18.2 vs 19.2 kg/m², p=0.03) and body fat percentage (19.1 vs 23.6%, p<0.005) compared to non-dancers. There were otherwise no significant differences in other basic anthropometric and baseline BMD measurements in the two groups. At the 24 month-assessment, DXA BMD values were consistently higher in both groups, though the increment was significantly greater in the dancers as compared to non-dancers (Δ lumbar spine 0.0758 Vs 0.0329 kg/cm², p=0.006, Δ neck of femur 0.046 Vs 0.019 kg/cm², p=0.004). QUS also showed a larger increment in dance students as compared to non-dancers (Δ soundness 18.1 Vs 6.99, p=0.033; Δ BMD 0.030 Vs 0.01kg/cm², p=0.048). pQCT showed largely positive increments in both groups, but the magnitude was not significantly different between the two groups.

Conclusion: The findings confirmed that both adolescent dance students and non-dancers showed an increment in BMD values over the 24 month study interval. The differential increments were apparently better detected by conventional DXA as well as by QUS of the os calcis compared to pQCT measurements

Table 1. Comparing basic characteristics and initial assessment of dancers and non-exercising subjects

	Dancers N=26 (SD)	Non-exercising N=14 (SD)	p-value	Mean difference (95% CI)
Age	18.3 (1.41)	18.6 (0.74)	0.47	-0.30 (-1.12 to 0.53)
Height (cm)	159.1 (3.69)	158.4 (5.92)	0.65	0.69 (-2.38 to 3.76)
Weight (kg)	46.1 (3.52)	48.5 (6.58)	0.14	-2.39 (-5.61 to 0.81)
BMI (kg/m ²)	18.2 (1.18)	19.2 (1.90)	0.03	-1.05 (-2.04 to -0.066)
Body Fat	19.1 (3.44)	23.6 (3.52)	<0.001	-4.45 (-0.677 to -2.12)
Lumbar spine L2-L4 (g/cm ²)	0.921 (0.089)	0.968 (0.134)	0.19	-0.046 (-0.11 to 0.025)
Mean neck of femur (g/cm ²)	0.903 (0.077)	0.874 (0.136)	0.38	0.029 (-0.038 to 0.097)
Mean Ward's triangle (g/cm ²)	0.746 (0.092)	0.768(0.142)	0.57	-0.021 (-0.096 to 0.054)
Mean Trochanter (g/cm ²)	0.753 (0.081)	0.719 (0.122)	0.30	0.033 (-0.031 to 0.099)
Distal radius(core) (mg/cm ³)	274.04 (68.4)	272.68 (78.17)	0.95	1.35 (-45.96 to 48.67)
Distal radius (total) (mg/cm ³)	610.16 (59.46)	598.68 (53.62)	0.53	11.47 (-25.91 to 48.87)
Mean tibia (core) (mg/cm ³)	312.66 (45.85)	309.81 (37.21)	0.83	2.85 (-25 to 30.7)
Mean tibia (total) (mg/cm ³)	625.54 (133)	602.43 (94)	0.55	23.1 (-55 to 101)

Table 2. Comparison of interval change after 24 months between exercising and non-exercising subjects

	Dancers N=26 (SD)	Non-exercising N=14 (SD)	p-value	Mean difference (95% CI)
Weight change (kg)	-0.38 (1.06)	0 (1.03)	0.27	-0.38 (-1.09 to 0.31)
BMI change (kg/m ²)	-0.155 (0.423)	0.031 (0.441)	0.18	-0.187 (-0.469 to 0.094)
Body fat change %	-0.107 (2.24)	-1.92 (2.55)	0.025	1.82 (0.241 to 3.4)
Lumbar L2-L4 (g/cm ²)	0.0758 (0.0523)	0.0179 (0.0239)	<0.001	0.057 (0.027 to 0.088)
Neck of femur (g/cm ²)	0.0459(0.0307)	0.0098 (0.0111)	< 0.001	0.036 (0.018 to 0.053)
Ward's triangle (g/cm ²)	0.0369 (0.0247)	0.0094 (0.015)	0.001	0.0275 (0.012 to 0.042)
QUS os calcis Soundness	18.1 10.6	6.99 (21.4)	0.033	11.1 (0.93 to 21.37)
QUS ox calcis BMD (g/cm ²)	0.0306(0.031)	0.01(0.027)	0.048	0.020 (0.0001 to 0.04)
Trochanter (g/cm ²)	0.0262 (0.0314)	0.0129 (0.0114)	0.13	0.013 (- 0.004 to 0.031)
Distal radius(core) (mg/cm ³)	12.76 (10.57)	12.57 (8.24)	0.95	0.197 (-6.4 to 6.8)
Distal radius (total) (mg/cm ³)	19.30 (17.35)	23.28 (20.30)	0.51	-3.97 (-16.33 to 8.38)
Mean tibia (core) (mg/cm ³)	11.3 (8.24)	13 (5.9)	0.49	-1.72 (-6.77 to 3.32)
Mean tibia (total) (mg/cm ³)	19.19 (13.44)	22.78 (13.99)	0.43	-3.59 (-12.74 to 5.55)