

Differences in bone strength and cortical bone parameters in young Swedish women with Type 1 diabetes

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Background

The incidence of Type 1 diabetes (T1D) is rising globally and the prevalence in Sweden is one of the highest worldwide. Sweden also has among the highest incidence of osteoporosis in the world. Fractures are more often seen in adult females, in addition T1D is a risk factor.

Purpose

We aimed to investigate bone health in young females with a T1D duration of at least 10 years in relation to healthy, matched controls.

Methods

Twenty-three Swedish females, aged 19.2–27.9 years, with a T1D duration of ≥10 years, were recruited from the Swedish National Diabetes Registry (NDR). A healthy control group, matched for age, gender and geography was used for comparison. Clinical data and biochemical assessments are shown in Table 2 and 3.

Dual-energy X-ray absorptiometry (DXA) and peripheral quantitative computed tomography (pQCT) were used to assess bone mass. Data regarding the T1D participants was retrieved from both the NDR and the national Swedish Paediatric Diabetes Quality Registry (SWEDIABKIDS). A questionnaire regarding current diseases, previous fractures and degree of physical activity was used.



Conclusion

This study demonstrates decreased bone strength and altered cortical bone parameters in young females with long-duration T1D. These findings warrant further attention towards improving bone health in patients with T1D.

Table 2. Clinical data of subjects with T1D and matched healthy controls

	T1D (n=23)	Controls (n=23)	P-value
Age (years)	24.3 (2.7) 24.7 (19.2; 27.9)	24.0 (2.6) 24.5 (19.2; 27.6)	0.61
Weight (kg)	65.1 (9.8) 67.7 (47.9; 86.3)	64.8 (6.3) 65.4 (53.8; 76.1)	0.96
Height (m)	1.66 (0.06) 1.66 (1.53; 1.81)	1.71 (0.06) 1.70 (1.62; 1.82)	<0.01
BMI (kg/m ²)	23.7 (3.5) 24.1 (17.4; 30.0)	22.3 (2.0) 22.2 (18.4; 26.3)	0.13
Comorbidities (other than T1D)	4 (17.4%)	4 (17.4%)	1.00
Medications (other than insulin)	15 (65.2%)	5 (21.7%)	<0.01
Fracture	3 (13.0%)	7 (30.4%)	0.28
Smoking	2 (8.7%)	1 (4.3%)	1.00
Physical activity (IPAQ, MET-min/week)	3407 (2093) 2739 (96; 9702)	3347 (2298) 2079 (392; 12288)	0.68

Table 3. Clinical data and biochemical assessments of subjects with T1D

	T1D (n=23)
Age at diabetes onset (years)	5.74 (2.83) 5.00 (1.00; 11.00)
Diabetes duration (years)	18.9 (2.2) 18.5 (15.8; 23.0)
Last HbA1c measurement (mmol/mol)	68.1 (13.0) 63.0 (49.0; 94.0)
HbA1c since 18 years of age (mmol/mol)	72.1 (15.8) 69.2 (49.1; 108.5)
HbA1c, 0–8.9 years (mmol/mol)	59.3 (12.3) 58.8 (25.5; 106.9)
HbA1c, 9.0–13.9 years (mmol/mol)	64.3 (11.9) 64.0 (31.3; 94.0)
HbA1c, 14.0–18.0 years (mmol/mol)	69.7 (13.8) 69.2 (35.3; 107.0)

Results

The individuals with T1D had an average diabetes duration of 18.9 years and a long-term suboptimal or poor metabolic control. No differences were found between the study groups for weight and body mass index (BMI). Females with T1D were significantly shorter than individuals in the control group. No differences were found between the T1D and control groups for total, lumbar spine and femur areal bone mineral density, or for lumbar spine bone mineral content (BMC). Total body BMC was lower in the T1D group in comparison with the control group; however, this difference was no longer apparent when total body BMC was adjusted for BMI, physical activity and height.

Data from the pQCT measurements did not reveal any differences between the T1D and control groups for trabecular density, cortical area, cortical thickness, endosteal or periosteal circumference. However, a higher cortical density (when adjusted for BMI, physical activity and height) was observed for the T1D group, (p-value 0.020). The bone strength index of cortical bone, SSI, was significantly lower among females with T1D (p-value 0.0049). The results are shown in Table 1.

Table 1. Analyses of DXA and pQCT in subjects with T1D and matched healthy controls

	T1D (n=23)	Controls (n=23)	Unadjusted P-value	Adjusted P-value for physical activity and BMI	Adjusted P-value for physical activity, BMI and height	Difference between groups, mean (95% CI)
DXA measurements						
Total-body aBMD (g/cm ²)	1.15 (0.14) 1.10 (0.94; 1.44)	1.20 (0.09) 1.19 (0.99; 1.36)	0.19	0.046	0.29	-0.065 (-0.129; -0.001)
Lumbar spine (L1-L4) aBMD (g/cm ²)	1.28 (0.15) 1.28 (1.04; 1.58)	1.26 (0.15) 1.21 (1.05; 1.53)	0.61	0.72	0.34	0.015 (-0.067; 0.097)
Lumbar spine (L1-L4) BMC (g)	65.3 (14.2) 64.4 (45.3; 93.0)	66.8 (9.2) 66.8 (47.9; 83.5)	0.68	0.66	0.34	-1.60 (-9.01; 5.81)
Total-body BMC (g)	2424 (422) 2372 (1772; 3231)	2634 (263) 2642 (1910; 3121)	0.049	0.025	0.34	-246 (-459; 33)
Total femur left aBMD (g/cm ²)	1.08 (0.18) 1.02 (0.74; 1.53)	1.11 (0.12) 1.09 (0.84; 1.38)	0.22	0.070	0.44	-0.085 (-0.177; 0.007)
Total femur mean aBMD (g/cm ²)	1.06 (0.18) 1.02 (0.76; 1.52)	1.11 (0.12) 1.08 (0.86; 1.37)	0.26	0.090	0.46	-0.076 (-0.165; 0.013)
pQCT measurements, tibia						
Total area (mm ²)	1048 (126) 1046 (813; 1262)	1073 (124) 1089 (766; 1303)	0.50	0.56	0.80	-25.4 (-112.0; 61.2)
Trabecular density (mg/cm ³)	239.9 (30.6) 248.9 (168.3; 289.7)	250.4 (39.8) 245.0 (190.3; 343.3)	0.32	0.12	0.16	-17.71 (-40.49; 5.07)
Cortical density (mg/cm ³)	1167 (19) 1160 (1132; 1198)	1152 (20) 1157 (1109; 1192)	0.014	0.0029	0.020	19.72 (7.16; 32.28)
SSI (mm ²)	1875 (399) 1803 (1342; 2581)	2277 (332) 2301 (1680; 2948)	0.0006	0.0007	0.0049	-425.1 (-659.7; -190.4)
Total area (bone area) (mm ²)	588 (97) 574 (449; 807)	661 (69) 676 (519; 757)	0.0050	0.0058	0.088	-79.9 (-135.3; -24.5)
Cortical area (bone area) (mm ²)	344.3 (60.1) 336.5 (253.5; 464.3)	372.6 (45.7) 373.0 (281.0; 438.0)	0.079	0.032	0.35	-36.1 (-69.0; -3.2)
Endosteal circumference (mm) (66%)	110.9 (6.9) 110.4 (97.6; 121.3)	112.2 (7.3) 113.5 (93.8; 124.8)	0.54	0.58	0.87	-1.3 (-6.2; 3.5)
Periosteal circumference (mm) (66%)	112.9 (7.0) 112.7 (98.7; 124.0)	114.4 (6.5) 115.1 (96.8; 125.1)	0.47	0.51	0.85	-1.5 (-6.3; 3.2)
Cortical thickness (mm)	0.323 (0.168) 0.271 (0.091; 0.728)	0.351 (0.230) 0.380 (0.046; 0.926)	0.65	0.62	0.93	-0.032 (-0.162; 0.098)

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