

# A prospective five-year cohort study of bone structure in males and females with diabetes



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## Abstract

There is cross-sectional evidence that adult men, but not pre- or perimenopausal women, with type 1 diabetes have reduced bone mineral density (BMD), especially at the hip and femoral neck. The aim of the present longitudinal study was to determine whether the rate of skeletal mineral loss over time is also greatest at these sites in this patient group. We studied 53 patients (26 with type 1 and 27 with type 2 diabetes) who underwent BMD measurement at hip, spine (L1-L4) and forearm using dual-energy X-ray absorptiometry (Hologic 4500A) at baseline and then 5 years later. At baseline, the type 1 patients were of mean age  $48.7 \pm 11.6$  years, 65% were males and their median [inter-quartile range] diabetes duration was  $12.6$  [7.2-27.0] years. The type 2 patients were aged  $65.0 \pm 9.0$  years, 59% were males and their diabetes duration was  $8.7$  [7.6-12.8] years. There were no significant BMD changes at any site in the type 1 females ( $P > 0.16$ ) despite their perimenopausal status. However, in the male type 1 patients, there was a significant reduction in BMD at the femoral neck ( $0.804 \pm 0.145$  vs  $0.769 \pm 0.129$  g/cm<sup>2</sup>;  $P = 0.002$ ) and a smaller fall at the total hip ( $0.989 \pm 0.168$  vs  $0.974 \pm 0.172$  g/cm<sup>2</sup>;  $P = 0.08$ ). Changes in BMD at spine and forearm were all  $P > 0.12$ . In the mostly postmenopausal type 2 females, there were significant reductions ( $P < 0.022$ ) in BMD at all sites except lumbar spine; the fall in BMD at the femoral neck ( $0.779 \pm 0.119$  vs  $0.742 \pm 0.090$  g/cm<sup>2</sup>,  $P = 0.019$ ) in this group was similar to that in the type 1 males. The type 2 males did not have a reduction in BMD at any site ( $P > 0.75$ ). These data show that male adults with type 1 diabetes are at sustained increased risk of demineralisation at the femoral neck. The reduction in BMD occurs at a rate equivalent to that in older post-menopausal females with type 2 diabetes.

## Background

- The relationship between osteoporosis and type 1 diabetes mellitus appears complex (McNair P. *Dan Med Bull* 1988;35:109-121; Piepkorn B *et al. Horm Metab Res* 1997;29:584-91)
- A number of groups have reported reduced bone mineral density (BMD) in subjects with type 1 diabetes (Alexopoulou O, *et al. Diabetes Metab* 2006;32:453-8; Hadjidakis DJ, *et al. J Diabetes Complications* 2006;20:302-7; Liu EY, *et al. Diabetes Care* 2003;26:2365-9; Miazgowski T, *et al. Osteoporos Int* 1998;8:399-403; Munoz-Torres M, *et al. Calcif Tissue Int* 1996; 58:316-9; Rakic V, *et al. Diabetologia* 2006; 49:863-71; Vestergaard P. *Osteoporos Int* 2007;18:427-44)

- This has not, however, been a consistent finding (Lunt H, *et al. Diabetes Res Clin Pract* 1998;40:31-8; Olmos JM, *et al. Bone Miner* 1994;26:1-8; Rozadilla A, *et al. Joint Bone Spine* 2000;67:215-8)

- There may be a gender difference in BMD in type 1 diabetes, with more marked bone loss in males than females relative to matched control subjects (Hadjidakis DJ, *et al. J Diabetes Complications* 2006;20:302-7; Rakic V, *et al. Diabetologia* 2006; 49:863-71)

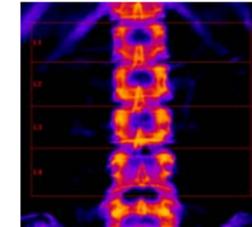
- These conclusions are based largely on cross-sectional data; little is known of the relative loss of skeletal calcium with time by gender and type of diabetes

## Objective

To determine whether the rate of skeletal mineral loss over time in adult males with type 1 diabetes is greater at hip and femoral neck compared with type 1 females and patients of either gender with type 2 diabetes

## Patients and methods

- In a previous study (Rakic V, *et al. Diabetologia* 2006; 49:863-71), we recruited a sample of 224 patients drawn from the community-based Fremantle Diabetes Study cohort
- 35 with type 1 diabetes and 189 type 2 diabetes; none had a history of osteoporosis or was on medication for this condition
- Each patient underwent dual energy X-ray absorptiometry (DEXA) scanning of hip, spine and forearm
- T-scores (comparison of BMD with the mean for healthy young people of the same gender) and Z-scores (comparison with the mean for the same age and gender) were generated



- A sub-group of 26 with type 1 and 27 with type 2 diabetes underwent repeat DEXA scanning using the same machine 5 years later

- The primary outcome of interest was the change in BMD in g/cm<sup>2</sup> over the 5 years

## Results

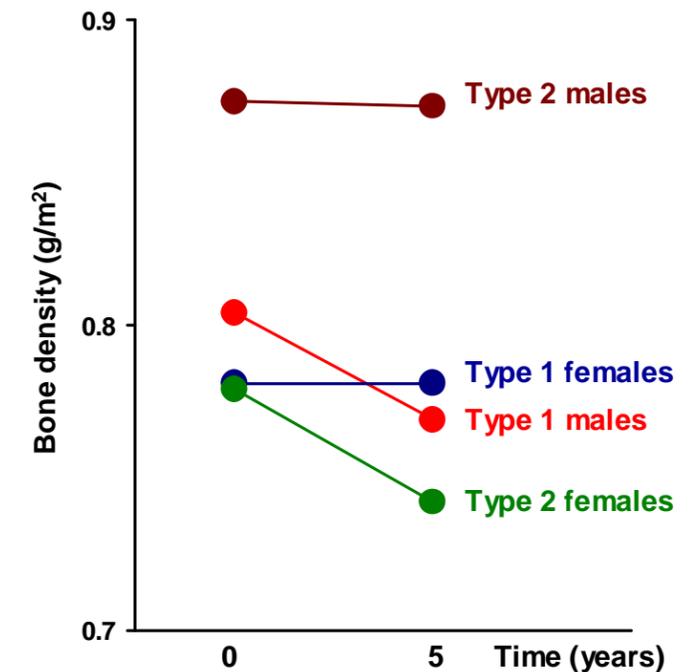
- At baseline, the type 1 patients were of mean  $\pm$ SD age  $48.7 \pm 11.6$  years, 65% were males and their median [inter-quartile range] diabetes duration was  $12.6$  [7.2-27.0] years; the type 2 patients were aged  $65.0 \pm 9.0$  years, 59% were males and their diabetes duration was  $8.7$  [7.6-12.8] years

- The type 1 patients were leaner (mean BMI  $26.2 \pm 4.3$  vs  $29.8 \pm 4.9$  kg/m<sup>2</sup>) but had worse glycemic control (HbA<sub>1c</sub>  $7.9$  [6.9-8.8] vs  $7.4$  [6.8-8.4]%) than the type 2 patients - only 3 of the type 2 patients (11%) were insulin-treated

- The percentages of patients who had exercised in the past 2 weeks (80% vs 82%), who were current smokers (19% vs 12%) and with any prior fracture (27% vs 22%) were similar in the type 1 vs type 2 patients, as were the number of standard drinks/day (0.3 [0-0.8] vs 0.1 [0-1.5]), but a lower percentage of women were post-menopausal in the type 1 group (33% vs 91%)

- There were no significant BMD changes at any site in the type 1 females ( $P > 0.16$ ) or type 2 males ( $P > 0.75$ )

## Change in femoral neck BMD over 5 years by gender and type of diabetes



- In type 1 males, there was a significant reduction in femoral neck BMD ( $0.804 \pm 0.145$  vs  $0.769 \pm 0.129$  g/cm<sup>2</sup>;  $P = 0.002$ , see Figure) and a smaller fall at total hip ( $0.989 \pm 0.168$  vs  $0.974 \pm 0.172$  g/cm<sup>2</sup>;  $P = 0.08$ ); changes in BMD at spine and forearm were all  $P > 0.12$

- In the type 2 females, there were reductions ( $P < 0.022$ ) in BMD at all sites except lumbar spine; the fall in femoral neck BMD ( $0.779 \pm 0.119$  vs  $0.742 \pm 0.090$  g/cm<sup>2</sup>,  $P = 0.019$ ) was similar to that in the type 1 males (see Figure)

## Conclusion

Adult males with type 1 diabetes are at sustained increased risk of demineralisation at the femoral neck. This occurs at a rate equivalent to that in older post-menopausal females with type 2 diabetes.