

# Osteoporosis: A possible aetiological factor in the development of Scheuermann's disease

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## ABSTRACT

The aim of this study was to test the hypothesis that spinal osteoporosis is an aetiological factor in the development of Scheuermann's disease in adolescents. Clinical and radiological data was collected on 12 individuals with Scheuermann's disease (SD). Lumbar spine bone mineral density (L2-4) was measured using dual energy X-ray absorptiometry. Age and sex-matched adolescents were used as controls. The number of standard deviations from the mean of age and sex-matched controls were calculated. In regards to results, SD patients demonstrated high bone densities of between 1 and 1.5 standard deviations above the mean of age-matched controls. These results suggest that osteoporosis is not an aetiological factor in Scheuermann's disease and that bone density measurements may indeed be higher than aged-matched controls in the general population.

**Key words:** *Scheuermann's disease, osteoporosis, aetiology*

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## INTRODUCTION

Scheuermann's disease (SD) is the most frequent cause of kyphosis in adolescence with a population prevalence of approximately 8.3%.<sup>4</sup> The diagnosis of Scheuermann's kyphosis is made from lateral radiographs of the thoracolumbar spine demonstrating irregularity of the vertebral end-plate with narrowing of the intervertebral disc spaces.<sup>13</sup> This often occurs in association with Schmorl's nodes and anterior wedging of the vertebral bodies.<sup>9</sup>

The aetiology of SD is unknown, although many theories have been proposed to explain the clinical and radiographic findings. In recent years, osteoporosis has been suggested as a possible aetiological factor in the development of spinal deformities.<sup>3,5,8</sup>

Bradford (1976) and Lopez (1988) both studied the role of osteoporosis in Scheuermann's disease using Single/Dual Photon absorptiometry bone density measurements.<sup>3,8</sup> They found that SD patients had lower bone mineral densities than control subjects. Gilsanz (1989) refuted their findings using quantitative CT measurements.<sup>5</sup>

The aim of this study was to assess the role of osteoporosis in the etiology of Scheuermann's disease using Dual energy X-ray absorptiometry (DEXA) scans. This method is now considered the gold standard for measuring bone mineral density (BMD).

## MATERIALS AND METHODS

### Patients

Twelve patients with idiopathic Scheuermann's disease involving either thoracic or thoracic and lumbar spine participated in this study. Inclusion criteria were that the spinal X-rays fulfilled Sorensen's modified radiological criteria for Scheuermann's disease. Patients were excluded if they had neurological or major medical diseases or were using prescribed medications that might affect BMD. Previous spinal surgery was also an exclusion. Informed consent was obtained from all patients and their parents/guardians. This study was approved by the Ethics Committees at Central Sydney and South Eastern Area Health Services.

### Bone densitometry

BMD of the lumbar spine (L2–4) was determined using dual energy X-ray absorptiometry (Lunar DPX-IQ, Madison, WI). The coefficient of variation for this technique is between 1–2%.

### Control data and Analysis

Control data from the Children's Hospital, Westmead, was used. This was based on scans of 166 females (mean age of 15.4) and 169 males (mean age of 14.5). The numbers of standard deviations from the mean of age and sex matched controls were calculated (Z score).

## RESULTS

Twelve patients participated in the study, 8 male and 4 female (Table 1). The average age was 14.1 (range 11–16). The mean height was 165.5 cm (range 145–179) and mean weight 61.9 kg (range 35–105). The mean lumbar Z score was 1.55 (range 0.0–3.9). None of the individuals scanned had a Z score below the control value.

Three of the above patients also underwent total thoracolumbar(TL) scanning. Similarly increased bone density measurements were found throughout the whole TL spine in this subset of patients.

**Table 1**  
**Scheuermann's Disease—Clinical details and Z scores**

	Male	Female	Total
Number of Patients	8	4	12
Mean Age (yr) (Range)	13.5 (11–16)	15.3 (15–16)	14.08 (11–16)
Mean Weight (kg) (Range)	66.4 (35–105)	53 (47–53)	61.9 (35–105)
Mean Height (cm) (Range)	166.1 (145–179)	164.3 (160–169)	165.5 (145–179)
Mean Lumbar Z score <sup>1</sup> (Range)	1.633 (0.1–3.9)	1.4 (0.0–3.3)	1.55 (0.0–3.9)

## DISCUSSION

Scheuermann's disease is a common cause of back pain in adolescents. It often presents in puberty as kyphosis of the thoracolumbar spine with or without associated pain. The aetiology of Scheuermann's disease is unknown, although many theories have been proposed. In some families genetic factors appear important, with autosomal dominant inheritance documented.<sup>6,11</sup> In addition, mechanical factors have been hypothesised to be involved in this condition, with theories relating to tightness of the anterior longitudinal ligaments as well as upright posture.<sup>3,7,12</sup>

The concept that osteoporosis is a contributing factor in the development of this disease is supported by a study by Lopez et al.<sup>8</sup> These investigators examined 10 individuals with SD using Dual Photon absorptiometry and demonstrated that they had reduced bone mineral density at both the spine and femoral neck as compared to seven age, sex, height and weight-matched controls. They also used Single Photon absorptiometry at the midshaft radius. Lopez et al concluded that a highly significant association existed between osteoporosis and Scheuermann's disease.

Bradford et al in 1976 examined 12 patients using dual photon absorptiometry on the midshaft radius as well as the femoral trabecular-pattern of Singh from radiographic studies.<sup>3</sup> They found a high frequency of low bone density measurements in their patient group. Subsequently Gilsanz et al used quantitative CT to assess whether adolescents with Scheuermann's disease had osteoporotic lumbar spines.<sup>5</sup> In this study they examined twenty adolescents and compared them to twenty age, sex and race matched controls. In comparison to the study by Lopez,<sup>8</sup> this study failed to find any statistical difference between the groups.

These studies used different methods to assess bone density with contrasting results, leaving the question of osteoporosis as an aetiological factor in SD unanswered. The aim of our study was to examine the hypothesis that osteoporosis is a contributing aetiological factor in the development of the kyphotic deformity in Scheuermann's disease using dual energy X-ray absorptiometry (DEXA). This is a safer and more reliable method than CT and is now accepted as the gold standard for the measurement of BMD. We have demonstrated high bone density in the lumbar spine in affected individuals when compared to age and sex-matched controls, suggesting that osteoporosis is not an aetiological factor in Scheuermann's disease. Thoracolumbar spine measurements (measured in 3 subjects) showed similar bone density increases as the lumbar spine. This suggested that bone density increases were not limited to the lumbar spine alone and may in fact point to a more generalized increase in bone density in patients with SD.

In the past there have been problems measuring BMD in adolescents due to lack of adequate control data. The Children's Hospital, Westmead, has recently established control values for this age group, making the interpretation of BMD data possible. Ideally, controls should be matched not only by age, sex and race but also height and weight. However, it is not logistically possible to exactly match every individual studied and variations in height and weight exist in the adolescent population even after age, sex and race

matching. Given these problems, however, we feel that our control group is a reasonable approximation.

The question thus arises: if osteoporosis is not an underlying cause for the radiological changes seen in SD, what alternative mechanisms might be responsible?

Attention has focused on defects in the cartilage end-plate (CEP) of vertebrae as a likely aetiological factor in SD.<sup>10</sup> The end-plate is responsible for vertical growth of the vertebral body and therefore any abnormality in this structure could theoretically lead to abnormal development in the growth phase of adolescence, clinically manifesting as vertebral wedging. In spines affected by Scheuermann's disease, larger and more numerous translucent areas have been found on the CEP when compared with normal spines.<sup>12</sup> Loss of mechanical stability, prolapse of disc material and reduction in the cartilage growth zone have all been associated with such end-plate defects. These findings point to a disturbance of collagen or ground substance biosynthesis in the cartilaginous end plate as probable aetiological factors. Future research efforts should focus on defects in the vertebral end-plate rather than on osteoporosis as a primary event in Scheuermann's disease.

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Study Conducted at Sydney Childrens' Hospital, Randwick, NSW, Australia

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