Lumbar Scoliosis in Postmenopausal Women: Prevalence and Relationship With Bone Density, Age, and Body Mass Index

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Study Design. Cross-sectional study.

Objective. The aim of this study was to investigate the prevalence of lumbar scoliosis in postmenopausal women aged 50 years and older, and to determine the association of adult lumbar scoliosis with age, osteoporosis, and body mass index (BMI).

Summary of Background Data. Adult scoliosis prevalence has not been clearly determined. In addition, limited data are available on the correlation of adult scoliosis with age, bone mineral density, and BMI.

Methods. We studied 380 postmenopausal women aged 50 years and older, who were evaluated with dual-energy radiograph absorptiometry (DXA) scan images. The lumbar curvature magnitude in the coronal plane was measured in DXA images with Cobb’s method. Scoliosis was defined by the presence of a curvature 10° or larger. Age and T-score in the lumbar spine and in both femoral necks were recorded, and BMI was calculated. Correlation analysis among the studied variables was performed, as well as a linear regression analysis to determine the effect of femoral neck T-score, spine T-score, age, and BMI as independent predictors of the Cobb angle in the lumbar spine.

Results. The prevalence of lumbar scoliosis was 12.9% (49 cases); 43 cases (11.3%) had lumbar curves 10° or more but less than 20°, and six cases (1.6%) had lumbar curves more than 20°. Age and BMI were independent predictors of the Cobb angle; the femoral neck T-score and the lumbar T-score were not independent predictors of the Cobb angle.

Conclusion. We found a 12.9% prevalence of lumbar scoliosis in postmenopausal women aged 50 years and older, most of them with mild curves. Age and BMI are independent predictors of lumbar scoliosis. Bone mineral density (BMD) is not an independent predictor of the magnitude of the curve.

Key words: adult scoliosis, scoliosis prevalence, osteoporosis, aging spine. Spine 2011;36:737–740

Adult scoliosis is an important condition affecting the aging spine. The impact of adult scoliosis has been previously reported, as scoliosis affecting the adult spine has a significant and measurable impact on health-related quality of life. The prevalence of adult scoliosis is an important measure of the overall burden of scoliosis on society, and the prevalence has not been well determined in population-based studies. Despite significant advances in the surgical management of adult scoliosis, and recent studies that have identified radiographic parameters that predict clinical symptoms and lead to surgical treatment, a limited number of studies have been conducted evaluating the epidemiology of this disorder.

As adult scoliosis is a common condition in the general population, with prevalence reported with wide variability, ranging from 1.4% to 68%. The source of variability is related to differences in definitions of scoliosis, methods of defining cohorts, sample size, and screening tools. An accurate measure of the prevalence of adult scoliosis is important in determining the impact of the disorder. Although many adults with scoliosis are asymptomatic, the disorder has a significant and measurable impact on pain, function, and quality of life in patients with symptomatic scoliosis. A population-based study of the prevalence of this condition based on widely applied screening tools will minimize selection bias of the cohort studied; such a study could obtain results that would better reflect the true prevalence of adult scoliosis.

Dual-energy radiograph absorptiometry (DXA) scanning is a routine screening study recommended for all women over 50 years of age. The screening tool provides an indiscriminant and nonbiased sample of the population of postmenopausal women. Several studies in adolescent idiopathic scoliosis have correlated the degree of deformity with bone mineral density (BMD) and body mass index (BMI), but few studies have evaluated the association of these factors with adult scoliosis. Osteoporosis has been implicated in the development of degenerative scoliosis in the adult, as it has been shown that patients with osteoporosis are more likely to exhibit scoliosis, and it has been suggested that mild scoliosis in the elderly is more common in patients with low femoral neck BMD, but scoliosis was not related to age or vertebral BMD.
The purpose of this study is to determine the prevalence of adult scoliosis in postmenopausal women 50 years old or older, and to define the relationship of adult scoliosis with age, BMD, and BMI in the same population.

MATERIALS AND METHODS

We studied 380 postmenopausal women aged 50 years and older, who were evaluated with DXA scans consecutively obtained at a University Hospital from January 2009. Institutional review board approval was obtained to conduct this study. The images were requested as screening of bone mass loss after menopause as a part of routine clinical care, independent of the presence of back symptoms. The lumbar curvature magnitude in the coronal plane was measured in DXA images with Cobb’s method if a curve was present on the anteroposterior view of the lumbar spine of the DXA scans; or between L1 and L5 if no obvious curve was seen. Scoliosis was defined by the presence of a curvature 10° or bigger. The curvature was measured by two of the authors (JE and CD-L); in addition, 20 of the cases were randomly chosen to determine the intra- and interobserver variability of Cobb angle measurement.

Exclusion criteria were the presence of instrumentation in the lumbar spine or bilateral hip arthroplasty. Patients with a history of malignancy were also excluded from study. To determine the sample size for the study, we assumed a condition with an unknown prevalence. The necessary sample size was 377 cases.

Weight and height were measured using standard techniques. BMI (kg/m²) was calculated as weight in kilograms divided by the square of the height in meters. Age, BMI, and T-score in the lumbar spine and in both femoral necks were also recorded.

A correlation analysis (Pearson) between the presence of scoliosis and predictor variables was performed. A linear regression analysis was performed to determine the impact of independent variables on the presence and magnitude of spinal deformity. Independent variables include femoral neck T-score, spine T-score, age, and BMI. A P < 0.05 was considered to be a statistically significant difference. Data were analyzed using SPSS™ version 10 (SPSS, Chicago, IL).

RESULTS

We studied 380 women aged 50 years and older, with a median age of 59.8 years (range: 50–90). The incidence of lumbar scoliosis was 12.9%, confidence interval 9.77% to 16.78% (49 cases). Among the patients who had scoliosis, 43 cases (11.3%) had lumbar curves 10° or more but less than 20°, and 6 cases (1.6%) had lumbar curves more than 20°. No cases studied showed a scoliosis curve more than 30° in the lumbar spine. The intraobserver variability of Cobb angle measurement was 1.13 ± 0.93°; the interobserver variability was 0.94 ± 0.1°.

The effect of age, BMI, and BMD was evaluated by performing a correlation analysis, which showed a small positive correlation of the Cobb angle with age (r = 0.26; P < 0.01) and a small negative correlation with femoral neck T-score (r = −0.15; P < 0.01) and BMI (r = −0.12; P = 0.02) (Figure 1). There was no correlation of the Cobb angle with the lumbar T-score (r = −0.44; P = 0.39).

A linear regression analysis was also done to evaluate whether each of these variables independently affected the Cobb angle. Age (β-coefficient = 0.146; P < 0.01) and BMI (β-coefficient = −0.145; P = 0.06) influenced the Cobb angle in linear regression; the adjusted r² value for the regression model is 0.079, and the regression equation resulted in: expected Cobb angle = −0.592 ± (0.146 × age) − (0.145 × BMI). The femoral neck T-score (β-coefficient = −0.018; P = 0.755) and the lumbar T-score (β-coefficient = 0.053; P = 0.308) were not independent predictors of Cobb angle.

DISCUSSION

This study found a prevalence of lumbar scoliosis of 12.9% in women 50 years and older, and the majority of curves were less than 20°. The presence of scoliosis was more common in patients who were older and who had a lower BMI.

Few studies have evaluated the prevalence of adult scoliosis, with rates reported from 1.4% to 68%. However, these studies have several limitations, including an insufficient number of cases studied, different screening methods, and different populations studied, which do not allow us to raise definite conclusions on scoliosis prevalence in adults. It is important that the screening method used should not produce a bias in the sample of patients studied. Thus, any imaging study that concentrates symptomatic patients (such as radiographs obtained from a large sample of patients) should be...
avoided. DXA has the advantage that it is an imaging examination routinely requested in most women after menopause as a screening of bone mass loss, independent of the presence of symptoms. Few previous studies have used DXA to determine a prevalence of scoliosis in adults, and our study included a cohort of patients who represent a nonselected sample of postmenopausal women. Using DXA for identification and measurement of scoliosis is limited to the lumbar spine; however, DXA scan imaging obtained in a supine position has demonstrated to have an excellent correlation (0.91) with standing anteroposterior lumbar radiographs; in addition, in our study we observed a very small intra- and interobserver variability in measurement of the Cobb angle in DXA scan imaging. Even the standard determination of Cobb angle in anteroposterior radiographs of the spine has been associated to a measurement error up to 3° to 5°, but any small error in measurement may be significant as most patients with scoliosis in our study had curvatures between 10° and 20°.

Adult scoliosis may represent a new-onset (degenerative) deformity or a pre-existing adolescent idiopathic scoliosis that progresses into adulthood. Older patients should have a higher prevalence of lumbar deformity because spinal degeneration, which has been implicated in the development of degenerative scoliosis, advances with age. In addition, patients with adolescent idiopathic scoliosis can continue their curve progression during adulthood. Our study showed that age and BMI were independent predictors of the magnitude of the curve, such that scoliosis was more common in older patients with a lower BMI. The analyses of our data, however, show that these variables have a low effect (although significant) over the magnitude of the curve, and 7.9% of the variance in Cobb angle can be explained by the regression model. There was no independent association between scoliosis and bone density in this study.

Previous studies in adolescent idiopathic scoliosis have shown that girls with idiopathic scoliosis have a lower BMI than age-matched controls. These publications agree with our results, which show that lower BMI is an independent predictor of the presence of scoliosis in adults. No previous studies have demonstrated an association of low BMI and adult scoliosis.

Adult scoliosis and osteoporosis are associated with advancing age, and are found simultaneously in many aging patients. Nonetheless, the effect of osteoporosis on the development of adult scoliosis, or the effect of scoliosis on the development of osteoporosis is not demonstrated in this study. Some reports suggest that scoliosis predisposes to osteoporosis, while other authors suggest that osteoporosis predisposes to scoliosis, or that there is no correlation. Previous studies have shown that adult scoliosis in the lumbar spine is associated to low femoral neck BMD but not to low vertebral BMD. Another study showed that adult women with scoliosis had a lumbar BMD similar to young women and above age-matched controls, but their femoral neck BMD was within a normal range for the patients’ age. A recent study, with a similar methodology to our study, also showed that adult scoliosis had a negative correlation to femoral neck T-score and a positive correlation with lumbar T-score. Adolescent idiopathic scoliosis, in contrast, has been associated with a lower vertebral BMD; these different results among adolescent idiopathic scoliosis and adult scoliosis may be explained as spinal degeneration would falsely increase lumbar BMD measurements in DXA scans. Although we found a mild negative correlation of the femoral neck T-score with the lumbar curvature would depend on the effect of age and BMI over the femoral neck BMD. Although osteoporosis and adult lumbar scoliosis are usually found in the same populations, from our results it is unlikely that osteoporosis itself is a major determinant of adult lumbar scoliosis as it has been suggested.

Adult scoliosis is an important condition affecting the aging spine. With an aging population, it is important to identify factors that are associated with the development of spinal deformity and the progression of deformity. This study demonstrates a small effect of advancing age and low BMI on the development of scoliosis; BMD values were not independent predictors of adult scoliosis. Further studies may include population-based screening of patients with nonradiographic methods, or identification of other reversible factors that may be associated with the development and progression of adult scoliosis.

**Key Points**

- Adult scoliosis prevalence has not been clearly determined.
- Limited data are available on the correlation of adult scoliosis with bone mineral density (BMD) and BMI.
- In postmenopausal women aged 50 years and older we found a 12.9% prevalence of lumbar scoliosis.
- Age and BMI are independent predictors of lumbar scoliosis. BMD is not an independent predictor of the magnitude of the curve.

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**References**


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