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ORIGINAL ARTICLE

The impact of lumbar scoliosis on pain, function and health-related quality of life in postmenopausal women

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Abstract The impact of adult scoliosis on pain, function and health-related quality of life (QOL) has not been clearly defined. A population-based study using widely applied screening tools could better reflect the impact of adult scoliosis. In this study, a visual analog pain scale assessment (VAS) for lumbar and leg pain, an Oswestry disability index (ODI) and a standard version of the Medical Outcome Study Short Form-36 (SF-36) questionnaire were sent by mail to 261 women of age 50 years and older, consecutively evaluated with dual-energy radiograph absorptiometry (DXA) scan images. 138 patients (32 with lumbar curves 10° or bigger) returned the questionnaires. Differences in lumbar VAS, leg VAS, ODI and SF-36 values between groups of patients with curves <10°, 10°–19° and ≥20° were evaluated. Correlation analyses of the Cobb angle, age and body mass index (BMI) with VAS, ODI and SF-36 values, and multivariate regression analysis were performed. Patients with curves <10°, 10°–19° and ≥20° had no significant differences in lumbar or leg VAS, ODI or SF-36 values. ODI values correlated with age and BMI; SF-36 values correlated with BMI only; lumbar and leg VAS values did not correlate with lumbar curvature, age or BMI. Regression disclosed that Cobb angle values did not influence ODI, SF-36 or VAS values. In postmenopausal women with mild and moderate lumbar curves, Cobb angle had no influence on pain, function and QOL; age and BMI had small effect.

Keywords Adult scoliosis · Pain · Disability · Health-related quality of life

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Introduction

Adult scoliosis is an important condition affecting the aging spine. With aging population, it is important to identify which factors influence the presence of symptoms in patients with scoliosis. Despite significant advances in the surgical management of adult scoliosis [1, 2] and recent studies that have identified radiographic parameters that predict clinical symptoms [3–5], the impact of adult scoliosis on pain, function and health-related quality of life (QOL) has not been clearly defined. Moreover, it is known that many adults with scoliosis are asymptomatic [2, 6–8].

The full impact of scoliosis is not well understood because most studies have focused only on patients who seek medical attention. Previous studies have shown contradictory results regarding symptoms associated with adult scoliosis; some authors have observed a similar incidence of low back pain (LBP) in patients with lumbar and thoracolumbar curves compared to the general population (albeit with more severe pain associated with bigger curves) [9, 10], while others have reported disabling pain among patients with adult scoliosis [11]. These varying results can be explained by the studies' use of different screening methods and study populations [8–10, 12]. A population-based study of the impact of adult scoliosis on pain, function, and health-related QOL based on widely applied screening tools will minimize selection bias of the

cohort studied; such a study can obtain results that will better reflect the true impact of adult scoliosis.

Dual-energy radiograph absorptiometry (DXA) scanning is a routine screening tool recommended for all women over 50 years of age that can provide data on spinal curvature for a random and non-biased sample of the population of postmenopausal women. The aim of our study is to determine the impact of adult scoliosis on back and leg pain through a visual analog pain scale assessment (VAS), function using the Oswestry disability index (ODI), and health-related QOL through the Medical Outcome Study Short Form-36 (SF-36) in postmenopausal women 50 years of age and older, and to define the relationship within this same population between those measurements and age, Cobb angle and BMI using DXA as the screening tool.

Methods

Institutional review board approval was obtained prior to performing this study. To determine the sample size for the study, we used our previous data that showed a 13% prevalence of scoliosis in postmenopausal women [13]; with a margin of error of 10% and a confidence level of 90%, the minimal number of patients with scoliosis that we should study was 31 cases.

Two co-authors, JE and CC, contacted by telephone 280 postmenopausal women 50 years and older, who were evaluated with DXA scan images, consecutively obtained at a University Hospital from January to April 2009. The images were requested as a means of screening for postmenopausal bone mass loss as 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 as the presence of lumbar curve that was 10° or bigger. Nineteen patients refused to participate. A consent agreement, a VAS assessment for lumbar and leg pain, an ODI, a SF-36 questionnaire, and a pre-stamped return envelope were sent to the remaining 261 patients. To recruit enough subjects with lumbar curves 10° or bigger, we called these women again 1 week after the questionnaires were sent. One hundred and thirty-eight patients (32 with curves 10° or larger) returned the consent forms to participate in this part of the study with the completed questionnaires.

Exclusion criteria were the presence of instrumentation in the lumbar spine, bilateral hip arthroplasty or history of malignancy. Weight and height were measured using standard techniques. BMI (kg/m^2) was calculated as weight divided by the square of the height in meters.

Differences in the lumbar VAS, leg VAS, ODI (×2) and SF-36 values between the groups of patients with curves <10°, 10°–19° and ≥20° were evaluated by the Kruskal–Wallis test. Correlation analyses (Spearman's rank correlation) between the Cobb angle, age and BMI with variables measuring pain, function, and health-related QOL (VAS, ODI and SF-36) were also performed. Multivariate regression analysis was also performed to determine the independent estimated impact of Cobb angle, age and BMI on VAS, ODI and SF-36 measurements.

We also evaluated if there were any differences in age, BMI, lumbar T score and femoral neck T score between the patients who answered the questionnaires and those that did not.

A p value less than 0.05 was considered statistically significant. Data were analyzed using Statistical Program for the Social Sciences (SPSS) version 18 (SPSS, Chicago, IL).

Results

We studied 138 women of age 50 years and older, with a median age of 60 years and a range from 50 to 90 years. Thirty-two patients had lumbar curves 10° or bigger as measured in DXA scan images. The curve magnitude, age and BMI of participating subjects are summarized in Table 1. The patients included in the study were not different than the women who did not participate in terms of age ($p = 0.85$), BMI ($p = 0.45$), lumbar T score ($p = 0.60$) and femoral neck T score ($p = 0.52$).

Patients with curves <10°, 10°–19° and ≥20° had no significant differences in lumbar VAS ($p = 0.48$) or in leg VAS scores ($p = 0.81$); the same groups did not show significant differences in ODI × 2 values ($p = 0.55$) or in SF-36 values either ($p = 0.98$), as shown in Table 2. The median values of the components of SF-36 are shown in Table 3.

The association of Cobb angle, age, and BMI with ODI, SF-36 and VAS pain scale values was evaluated using correlation analysis. ODI values presented a small positive correlation with age ($r = 0.219$, $p = 0.01$) and BMI ($r = 0.176$, $p = 0.039$). SF-36 values showed a small negative correlation with BMI only ($r = -0.212$, $p = 0.013$).

Table 1 Curve magnitude, age, and BMI of participating subjects

Variable	Median	Min	Max
Age (years)	60.0	50.00	90
BMI (kg/m^2)	25.6	18.0	47.7
Cobb's angle (°)	3.5	0	29

Table 2 Median values of lumbar and leg VAS, Oswestry ×2 and SF-36 in participating subjects with curves <10°, 10°–19° and >19° and the complete group

	Lumbar VAS ($p = 0.48$)	Leg VAS ($p = 0.81$)	Oswestry ×2 ($p = 0.55$)	SF-36 ($p = 0.98$)
Patients <10°	4	3	10	57.65
Patients 10°–19°	3	3	10	55.54
Patients >19°	1.5	3.5	9	59.09
Complete group	3.5	3	5	68

Table 3 Complete group description of SF-36 and SF-36 components values

Variable	Median	Min	Max
SF-36	68.0	13.1	97.0
GH	16.0	9.0	21.0
PF	24.0	10.0	30.0
RP	8.0	4.0	8.0
RE	6.0	3.0	6.0
SF	6.0	3.0	8.0
BP	5.0	2.0	10.0
VT	14.0	5.0	20.0
MH	20.0	9.0	24.0

GH General health scale, *PF* Physical functioning scale, *RP* Role physical scale, *RE* Role emotional scale, *SF* Social functioning scale, *BP* Bodily pain scale, *VT* Vitality scale, *MH* Mental health scale

Table 4 Correlations (Spearmann)

	Lumbar VAS	Leg VAS	Oswestry ×2	SF-36
Cobb angle				
Correlation coefficient	−0.012	0.005	0.072	0.057
p (2-tailed)	0.885	0.950	0.400	0.509
BMI				
Correlation coefficient	0.164	0.091	*0.176*	*−0.212*
p (2-tailed)	0.054	0.286	0.039	0.013
Age				
Correlation coefficient	−0.055	0.117	*0.219*	−0.137
p (2-tailed)	0.520	0.172	0.010	0.110

Significant values are italicized

Lumbar VAS values did not correlate with Cobb angle ($p = 0.885$), age ($p = 0.52$) or BMI ($p = 0.054$). Leg VAS values also did not correlate with Cobb angle ($p = 0.950$), age ($p = 0.172$) or BMI ($p = 0.286$), as shown in Table 4.

The analyses of the components of SF-36 revealed that only physical function had small negative correlations with age ($r = -0.255$, $p = 0.003$) and BMI ($r = -0.183$, $p = 0.032$), and general health presented a small positive correlation with BMI ($r = 0.174$, $p = 0.042$).

Multivariate linear regression analysis was also done to evaluate whether Cobb angle, age or BMI independently affected ODI, SF-36 and VAS values. Age influenced the ODI values (β-coefficient $= 0.347$, $p < 0.01$), the SF-36 values (β-coefficient $= -0.225$, $p < 0.01$) and the leg VAS scores (β-coefficient $= 0.189$, $p = 0.031$). BMI influenced only SF-36 values (β-coefficient $= 0.189$, $p = 0.023$). Cobb angle values did not influence ODI, SF-36 or VAS values. The results of multivariate linear regression were not different if we only included patients with lumbar scoliosis in the analyses (lumbar curve 10° or larger).

Discussion

This study demonstrates a small effect of advancing age on pain, function, and health-related QOL in postmenopausal women. BMI independently influenced only health-related QOL. However, in our population, the degree of lumbar curvature did not correlate with symptoms, and it was not an independent predictor of pain, function, or health-related QOL.

Adult scoliosis, which may represent a new-onset deformity or a pre-existing adolescent idiopathic scoliosis that progresses into adulthood, is a prevalent condition. However, few studies have evaluated the influence of scoliosis curvature on lumbar symptoms, and those that have explored this issue have found conflicting results. In a 50-year follow-up study of patients with adolescent idiopathic scoliosis who did not undergo surgery, Weinstein et al. [6] found that 61% of them reported chronic back pain; however, most patients reported only little or moderate back pain, while remaining productive and functional at a high level. Schwab et al. [8], who reported a 68% prevalence of adult scoliosis in 75 elderly volunteers, observed that although many patients had pain and dysfunction, there was a large group with no marked physical or social impairment in addition, they found no correlation between scoliosis and VAS scores. This same group had previously reported a lack of correlation of VAS and Cobb angle in a series of adult patients with scoliosis from their practice [14]. In a previous study in patients of age 50 years and older, Robin et al. [15] also did not find a direct relationship between the scoliosis and back pain. Recently, in a cross-sectional radiological study with 1,347 adult volunteers, Hong et al. [16] showed that patients with

scoliosis suffered from more severe pain than the normal population, but the symptoms (measured by VAS only) were not proportionate with the Cobb angle. Conversely, other studies have found a similar incidence of LBP in patients with lumbar and thoracolumbar curves compared to the general population, but pain increased with the degree of scoliotic curvature, especially for curves larger than 45° [9, 10]. Our results show that none of the measures used were influenced by the magnitude of Cobb angle; this can be explained by the non selected population studied, because we included a multivariate analysis of the variables influencing our scores, and because our study only included the patients with curves smaller than 30°.

Our data differ from other studies, since we not only measured the pain, but also determined the function and QOL. It is noteworthy that our study also shows that not only the differences in the VAS, ODI and SF-36 scores between the groups with curves <10°, 10°–19° and ≥20° do not reach statistical significance, but also the median values of the three groups do not reach a minimal clinically important difference either [17, 18]. This is important ,since a potential pitfall in evaluating pain, disability and QOL is considering only the statistical differences in outcome scores but not the clinical relevance of those differences.

Adult scoliosis is associated with advancing age [13, 15]. Lumbar deformities are more prevalent among older patients, because spinal degeneration increases with age and spinal degeneration has been implicated in the development of degenerative scoliosis [12, 19, 20]; in addition, patients with adolescent idiopathic scoliosis can continue their curve progression during adulthood [21, 22]. However, the effect of age on symptoms in adult scoliosis patients is controversial; Hong et al. [16] showed that despite a higher prevalence of scoliosis in older females and the presence of more severe pain in patients with scoliosis, the symptoms did not differ between different age groups in patients with scoliosis. Conversely, other studies have shown that the pain increases with age in adult patients with scoliosis [10]. Our data show that the effect of age on symptoms is independent of the curve magnitude; this effect of aging on back pain (independent of the presence of scoliosis) has not been previously clearly defined. In a large study of Danish twins, Leboeuf-Yde et al. [23] described that axial pain was not more common in the oldest groups, although pain was reported to be more long-lasting in older patients. However, a systematic review to determine the influence of aging on back pain showed that most studies that considered severe forms of back pain found an increase in prevalence with increasing age [24].

Our study also shows that BMI influences QOL (measured by SF-36) in postmenopausal women, independent of age and the degree of scoliosis; however, BMI did not independently influence disability or pain as measured by the axial or leg VAS. There are conflicting data regarding the potential association between body weight and the occurrence of LBP. Leboeuf-Yde [25] considered that high BMI is a possible weak risk factor for LBP, but it could not be established as a true cause. Mirtz et al. [26] concluded that there was no evidence connecting LBP with obesity. However, Heuch et al. [27] found in a large cross-sectional population-based study that individuals with high BMI were more likely to report LBP than those with BMI in normal range, with a stronger association for women than for men. These results are consistent with our data.

Among the causes that explain the conflicting results found in published studies are the varied screening methods used and the different populations studied [8–10, 12]. It is important that the screening method used did not produce a bias in the sample of patients studied. Thus, any imaging study that is limited to the symptomatic patients (e.g., radiographs obtained from a large sample of patients in a spine clinic) should be avoided. Our study utilized DXA as screening tool, which has the advantage of being an imaging tool routinely used in postmenopausal women to screen for bone mass loss, independent of the presence of symptoms. In addition, DXA scan imaging obtained in a supine position has proven to have an excellent correlation (0.91) with standing antero-posterior lumbar radiographs [28]; we also have shown an excellent intra- and inter-observer correlation in measurement of the Cobb angle in DXA scan imaging [13]. However, DXA did not allow us to determine the presence of degenerative disc disease severity, or the presence of lateral listhesis; we did not have sagittal views of the lumbar spine either to establish the presence of spondylolisthesis or sagittal imbalance, factors that may influence symptoms.

Another limitation of our study is that only 138 patients answered the questionnaires, which may represent a bias. Nonetheless, the group studied was not different in age, BMI or bone mineral density from the patients who did not answer the questionnaires. In addition, most of the patients who had scoliosis answered the questionnaires, which allowed us to include most patients who might have had a greater impact of this disease on pain or QOL from the presence of a lumbar curvature; however, we have to acknowledge that most patients had small curves.

Our study found that in postmenopausal women with mild and moderate lumbar curves, Cobb angle did not influence the presence of pain, function, and health-related QOL compared to patients without scoliosis. Further studies should help to identify curves, which are associated with the development of symptoms in adult scoliosis patients.

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References

1. Bridwell KH (2004) Selection of instrumentation and fusion levels for scoliosis: where to start and where to stop. Invited submission from the joint section meeting on disorders of the spine and peripheral nerves. J Neurosurg Spine 1:1–8. doi:10.3171/spi.2004.1.1.0001
2. Bridwell KH, Berven S, Edwards C 2nd, Glassman S, Hamill C, Schwab F (2007) The problems and limitations of applying evidence-based medicine to primary surgical treatment of adult spinal deformity. Spine 32:S135–S139. doi:10.1097/BRS.0b013e3181453e22
3. Glassman SD, Berven S, Bridwell K, Horton W, Dimar JR (2005) Correlation of radiographic parameters and clinical symptoms in adult scoliosis. Spine 30:682–688. doi:00007632-200503150-00016
4. Berven SH, Deviren V, Mitchell B, Wahba G, Hu SS, Bradford DS (2007) Operative management of degenerative scoliosis: an evidence-based approach to surgical strategies based on clinical and radiographic outcomes. Neurosurg Clin N Am 18:261–272. doi:10.1016/j.nec.2007.03.003
5. Ploumis A, Liu H, Mehbod AA, Transfeldt EE, Winter RB (2009) A correlation of radiographic and functional measurements in adult degenerative scoliosis. Spine 34:1581–1584. doi:10.1097/BRS.0b013e31819c94cc
6. Weinstein SL, Dolan LA, Spratt KF, Peterson KK, Spoonamore MJ, Ponseti IV (2003) Health and function of patients with untreated idiopathic scoliosis: a 50-year natural history study. JAMA 289:559–567. doi:joc21444
7. Weinstein SL, Zavala DC, Ponseti IV (1981) Idiopathic scoliosis: long-term follow-up and prognosis in untreated patients. J Bone Joint Surg Am 63:702–712
8. Schwab F, Dubey A, El Fegoun AB, Hwang K, Pagala M, Farcy JP (2005) Adult scoliosis: prevalence, SF-36, and nutritional parameters in an elderly volunteer population. Spine 30:1082–1085. doi:00007632-200505010-00017
9. Kostuik JP, Bentivoglio J (1981) The incidence of low-back pain in adult scoliosis. Spine 6:268–273
10. Jackson RP, Simmons EH, Stripinis D (1983) Incidence and severity of back pain in adult idiopathic scoliosis. Spine 8:749–756
11. Epstein JA, Epstein BS, Jones MD (1979) Symptomatic lumbar scoliosis with degenerative changes in the elderly. Spine 4:542–547
12. Perennou D, Marcelli C, Herisson C, Simon L (1994) Adult lumbar scoliosis. Epidemiologic aspects in a low-back pain population. Spine 19:123–128
13. Urrutia J, Diaz-Ledezma C, Espinosa J, Berven S (2011) Lumbar scoliosis in postmenopausal women: prevalence and relationship with bone density, age, and body mass index. Spine (Phila Pa 1976) 36:737–740. doi:10.1097/BRS.0b013e3181db7456
14. Schwab FJ, Smith VA, Biserni M, Gamez L, Farcy JP, Pagala M (2002) Adult scoliosis: a quantitative radiographic and clinical analysis. Spine 27:387–392
15. Robin GC, Span Y, Steinberg R, Makin M, Menczel J (1982) Scoliosis in the elderly: a follow-up study. Spine 7:355–359
16. Hong JY, Suh SW, Modi HN, Hur CY, Song HR, Park JH (2010) The prevalence and radiological findings in 1,347 elderly patients with scoliosis. J Bone Joint Surg Br 92:980–983. doi:10.1302/0301-620X.92B7.23331
17. Glassman SD, Copay AG, Berven SH, Polly DW, Subach BR, Carreon LY (2008) Defining substantial clinical benefit following lumbar spine arthrodesis. J Bone Joint Surg Am 90:1839–1847. doi:10.2106/JBJS.G.01095
18. Copay AG, Martin MM, Subach BR, Carreon LY, Glassman SD, Schuler TC, Berven S (2010) Assessment of spine surgery outcomes: inconsistency of change amongst outcome measurements. Spine J 10:291–296. doi:10.1016/j.spinee.2009.12.027
19. Benoist M (2003) Natural history of the aging spine. Eur Spine J 12(Suppl 2):S86–S89. doi:10.1007/s00586-003-0593-0
20. Daffner SD, Vaccaro AR (2003) Adult degenerative lumbar scoliosis. Am J Orthop (Belle Mead NJ) 32:77–82 discussion 82
21. Collis DK, Ponseti IV (1969) Long-term follow-up of patients with idiopathic scoliosis not treated surgically. J Bone Joint Surg Am 51:425–445
22. Weinstein SL, Ponseti IV (1983) Curve progression in idiopathic scoliosis. J Bone Joint Surg Am 65:447–455
23. Leboeuf-Yde C, Nielsen J, Kyvik KO, Fejer R, Hartvigsen J (2009) Pain in the lumbar, thoracic or cervical regions: do age and gender matter? A population-based study of 34, 902 Danish twins 20–71 years of age. BMC Musculoskelet Disord 10:39. doi:10.1186/1471-2474-10-39
24. Dionne CE, Dunn KM, Croft PR (2006) Does back pain prevalence really decrease with increasing age? A systematic review. Age Ageing 35:229–234. doi:10.1093/ageing/afj055
25. Leboeuf-Yde C (2000) Body weight and low back pain. A systematic literature review of 56 journal articles reporting on 65 epidemiologic studies. Spine 25:226–237 Phila Pa 1976
26. Mirtz TA, Greene L (2005) Is obesity a risk factor for low back pain? An example of using the evidence to answer a clinical question. Chiropr Osteopat 13:2. doi:10.1186/1746-1340-13-2
27. Heuch I, Hagen K, Nygaard O, Zwart JA (2010) The impact of body mass index on the prevalence of low back pain: the HUNT study. Spine 35:764–768. doi:10.1097/BRS.0b013e3181ba1531
28. Pappou IP, Girardi FP, Sandhu HS, Parvataneni HK, Cammisa FP, Cammisa FP Jr, Schneider R, Frelinghuysen P, Lane JM (2006) Discordantly high spinal bone mineral density values in patients with adult lumbar scoliosis. Spine 31:1614–1620. doi:10.1097/01.brs.0000222030.32171.5f