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Does location of vertebral deformity within the spine influence back pain and disability?

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Abstract

***Objective*—Vertebral deformity is associated with back pain and disability. The aim of this analysis was to determine whether location within the spine influences the strength of association between vertebral deformity, back pain and disability.**

***Methods*—Men and women aged 50 years and over were recruited from population registers in 30 European centres. Subjects were invited for an interviewer administered questionnaire, and for lateral spinal radiographs. The questionnaire included questions about back pain, general health and functional ability. The spinal radiographs were evaluated morphometrically and vertebral deformity defined according to the McCloskey-Kanis method.**

***Results*—756 (11.7%) men and 885 (11.8%) women had evidence of one or more vertebral deformities. Among women with a single deformity, after adjusting for age and centre, those with a lumbar deformity were more likely than those with a thoracic deformity to report back pain, both currently (OR=1.4; 95% CI 1.0, 2.0) and in the past year (OR=1.5; 95% CI 1.0, 2.3). No association was observed in men. Among women with two deformities, those with adjacent deformities were more likely than those with non-adjacent deformities to report poor general health (OR=2.2; 95%CI 0.9, 5.6), impaired functional ability (OR=1.9; 95%CI 0.8, 4.7) and current back pain (OR=2.1; 95%CI 0.9, 4.9), though none of these associations were statistically significant. By contrast, among men, non-adjacent deformities were associated with impaired functional ability compared with those with adjacent deformities.**

***Conclusion*—Location within the spine influences the strength of association between self reported health factors and vertebral deformity.**

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Vertebral deformity is one of the cardinal manifestations of osteoporosis. Data from many studies, including the European Vertebral Osteoporosis Study (EVOS), suggest that vertebral deformity is associated with back pain and disability,[1–6] and that the strength of the associations increases with increasing number and severity of deformities.[5 6]

There is some evidence from studies in women with established osteoporosis that the "site" of vertebral deformities within the spine may also influence outcome.[7 8] To our knowledge, however, there are no population data concerning the influence of site on the occurrence of back pain and disability. Furthermore the influence of other spatial characteristics, including the relative position (adjacent/non-adjacent) in those with multiple deformities is unknown.

The aim of this analysis was to investigate the hypothesis that location, including site (thoracic/lumbar) and relative position (adjacent/non-adjacent) influences the relation between self reported health factors including back pain and disability and vertebral deformity.

Methods

The subjects included in this analysis were recruited during the course of a multi-centre population based survey of vertebral osteoporosis—the European Vertebral Osteoporosis Study (EVOS). The detailed methods of this study are reported elsewhere.[9] In brief, subjects were recruited from population based registers. Stratified random sampling was used with the aim of recruiting in each centre, a target number of 50 subjects in each of six, five year age and sex bands, 50–54, 55–59, 60–64, 65–69, 70–75, and 75 years and over. Subjects were invited to attend for an interviewer administered lifestyle questionnaire and lateral radiographs of the thoracic and lumbar spine.

The questionnaire included questions about back pain: currently and in the past year (response set = yes/no). Subjects were asked to rate their overall general health on a five point scale (response set=very good/good/satisfactory/not so good/poor). They were also asked a 12 item, back specific, activities of daily living instrument (ADLs), (response set for each item=Can do without difficulty/Can do with some difficulty/Can't do or only with help), see appendix.[10]

The spinal radiographs were forwarded to Berlin where they were evaluated morphometrically by one of three observers. Vertebral deformity was defined morphometrically according to the McCloskey-Kanis method.[11]

ANALYSIS

The self reported health factors were categorised: poor general health (poor, not so good *v* satisfactory, good, very good), back pain (yes *v* no), impaired functional ability (some or more difficulty in performing five or more ADLs *v* no difficulty performing any ADLs, or, some or more difficulty in performing less than five ADLs).

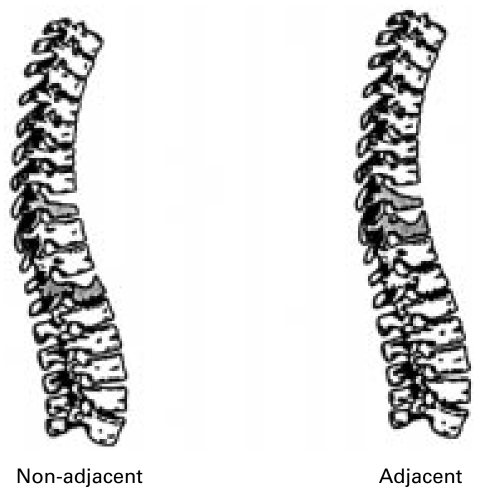

Figure 1 Adjacent and non-adjacent vertebral deformities.

To explore the influence of site we restricted the analysis to subjects with a single deformity and categorised participants as having either a thoracic or lumbar deformity. To explore the influence of "relative position" we restricted the analysis to subjects with two deformities and categorised participants as having deformities that were either adjacent or non-adjacent, see figure 1.

Logistic regression was used to explore the association between the location of vertebral deformity (site and relative position) and the various self reported health factors, the results being expressed as odds ratios and 95% confidence limits. In all analyses the self reported health factor was the dependent variable. Adjustments were made for age and centre and analyses performed separately in men and women.

Results

SUBJECT CHARACTERISTICS

In total 7530 women and 6449 men, aged 50–79 years, from 30 centres, were included in this analysis. Data from five centres were excluded because of small numbers or absence of data concerning self reported health factors. In total 756 (11.7%) men and 885 (11.8%) women had evidence of one or more vertebral deformities. Five hundred and ninety six women and 528 men had single deformities of whom 65% and 63% respectively were located in the thoracic spine. One hundred and forty five women and 127 men had two deformities of whom 47% and 50% respectively were adjacent.

INFLUENCE OF SITE

Table 1 shows the frequency of the self reported health factors in subjects with and without single vertebral deformity, by site and sex. At both thoracic and lumbar spine, compared with men, women were more likely to report back pain, poor health and functional impairment.

Among women, those with a single vertebral deformity (at both lumbar and thoracic spine) were more likely to report functional impairment, and poor health than those without vertebral deformity. Back pain was more frequent in women with single deformities though the difference was significant for lumbar deformities only (back pain was slightly less frequent among women greater than compared with those less than 65 years, however, this was true both for those with and without lumbar deformity (data not shown)). Among men, the direction of these differences was similar, though, the majority were not statistically significant (table 1).

Among women, compared with those with a deformity of the thoracic spine, those with a deformity of the lumbar spine were more likely to report back pain, currently and in the past year, and functional impairment (table 1). After adjusting for age and centre, compared with those with a single thoracic deformity, those with a single deformity at the lumbar spine were more likely to report back pain, both currently (OR=1.4; 95%CI 1.0, 2.0) and in the past year (OR=1.5; 95%CI 1.0, 2.3) (table 2). There was no association, however, with poor health or functional impairment and no association with any of these self reported health factors in men.

INFLUENCE OF RELATIVE POSITION

Among women with two deformities, those in whom the deformities were adjacent reported more back pain, poor health and functional impairment than those in whom the deformities were non-adjacent (table 3). In contrast, in men those with non-adjacent deformities reported more functional impairment. None of these differences attained statistical significance.

In regression analysis, among women, after adjusting for age and centre, those with adjacent deformities were more likely to report back pain both currently (OR=2.1; 95%CI 0.9, 4.9) and in the past year (OR=1.6; 95%CI 0.7, 3.8), functional impairment (OR=1.9 ; 95%CI 0.8, 4.7), and poor health (OR=2.2 ; 95%CI 0.9, 5.6) (table 2), though in part because of the relatively small numbers the confidence intervals around these estimates embraced unity. Among men, in contrast with women, those with adjacent deformities were less likely to report functional impairment (OR=0.3; 95%CI 0.1, 0.9) (table 2). There was no association between vertebral deformity and any of the other self reported health factors in men.

Table 1 Frequency of back pain, poor health and functional impairment, by sex and site

Sex	Variable			No deformity	Site* Thoracic	Lumbar
				(n=6645)	(n=388)	(n=208)
Women	Back pain†:	Current	(%)	39	42	51.4[1,2]
		Past year	(%)	60.6	62.9	72.6[1,2]
	Functional impairment‡		(%)	34.2	42.7[2]	51.5[1,2]
	Poor health§		(%)	25.8	30.9[2]	33.8[2]
				(n=5693)	(n=333)	(n=195)
Men	Back pain†:	Current	(%)	27.6	27.9	29.7
		Past year	(%)	48.5	50.5	48.7
	Functional impairment‡		(%)	19.1	23.5	24.9
	Poor health§		(%)	19	22.8	26.8[2]

*Subjects with one deformity. †Yes *v* No. ‡Difficulty performing ⩾5 ADLs *v* No difficulty or difficulty performing <5 ADLs. §Poor, Not so good *v* Satisfactory, Good, Very Good. [1]p<0.05, Lumbar *v* thoracic. [2]p<0.05, Compared with those with no deformity.

Table 2 Association between location (site and relative position) of vertebral deformity, back pain, poor health and functional impairment

Variable	Functional impairment* OR (95% CI)	Back pain† current OR (95% CI)	Back pain† past year OR (95% CI)	General health‡ OR (95% CI)
Women				
Lumbar *v* thoracic§	1.2 (0.8, 1.7)	1.4 (1.0, 2.0)	1.5 (1.0, 2.3)	1.1 (0.7, 1.6)
Adjacent *v* non-adjacent¶	1.9 (0.8, 4.7)	2.1 (0.9, 4.9)	1.6 (0.7, 3.8)	2.2 (0.9, 5.6)
Men				
Lumbar *v* thoracic§	1.1 (0.7, 1.7)	1.2 (0.8, 1.8)	0.9 (0.6, 1.4)	1.3 (0.8, 2.0)
Adjacent *v* non-adjacent¶	0.3 (0.1, 0.9)	0.6 (0.2, 1.6)	0.6 (0.3, 1.6)	0.9 (0.3, 2.9)

All analyses adjusted for age and centre. Dependent variable — self reported health. *Difficulty performing ≥5 ADLs *v* No difficulty or difficulty performing <5 ADLs. †Yes *v* no. ‡Poor, Not so good *v* Satisfactory, Good, Very Good. §In those with a single deformity. ¶In those with two deformities.

Table 3 Frequency of back pain, poor health and functional impairment, by sex and relative position

				*Relative position**	
Sex	*Variable*			*Adjacent*	*Non-adjacent*
				(n=68)	(n=77)
Women	Back pain†:	Current	(%)	42.7	39
		Past year	(%)	66.2	59.7
	Functional impairment‡		(%)	49.2[1]	42.1
	Poor health§		(%)	35.3	28.6
				(n=64)	(n=63)
Men	Back pain†:	Current	(%)	32.8	33.3
		Past year	(%)	51.6	52.4
	Functional impairment‡		(%)	24.2	30.2
	Poor health§		(%)	20.3	20.6

*Subjects with two deformities. †Yes *v* no. ‡Difficulty performing ≥5 ADLs *v* No difficulty or difficulty performing <5 ADLs. §Poor, Not so good *v* Satisfactory, Good, Very Good. [1]p<0.05, Compared with those with no deformity.

Discussion

In this population survey, women with lumbar deformities were more likely to report back pain than those with thoracic deformities. In women, deformities that were adjacent were linked with back pain, functional impairment, and poor health, while among men non-adjacent deformities were associated with functional impairment.

Several limitations need to be considered in interpreting these findings. The study was cross sectional and it is not therefore possible to determine the temporal nature of the observed associations. It is possible, for example, that poor health or impaired function (because of other reasons), may have resulted in a person becoming less mobile and as a result increased their susceptibility to osteoporosis and fracture.

It was not possible to date the onset of the deformity. In some people back pain may have preceded the onset of deformity (by many years) while in others, participants with pre-existing deformity may have developed back pain or functional impairment for other reasons (for example, disc disease). Any such misclassification of back pain is likely, however, to have resulted in an underestimation of the strength of the associations.

The questionnaire instrument was developed with the purpose of obtaining comparative data across the different countries into which its use was intended. It therefore lacked the precision that would have been possible in a single centre study. In a limited survey the reproducibility of questions concerning back pain and general health was good.[12] Because interviewers were unaware of the disease status of the subjects at interview any misclassification of symptoms because of imprecision is likely to have been random and therefore to have reduced the chance of finding significant associations.

Previous studies that looked at site of deformities within the spine and health impact have been undertaken in women with established osteoporosis. Ryan in a clinic based study found that the severity and duration of thoracic back pain was correlated with the number of deformities in the upper thoracic spine, and functional impairment with number of deformities in the lower thoracic spine.[7] Studies in women with established disease are, however, subject to biases of selection and the results therefore difficult to generalise. In a group of women participating in a clinical trial, Silverman found that deformities at the thoracolumbar junction and lumbar spine had a greater impact on health related quality of life than deformities elsewhere.[8]

Our data, derived from a population setting, suggest that in women deformities in the lumbar spine are more strongly associated with back pain than deformities in the thoracic spine. The mechanism for this is unknown though it may be a consequence of the greater mechanical load on the lumbar spine and increased stimulation of local nociceptors.

Cooper reported that women with vertebral deformity (including thoracic and lumbar) who come to clinical attention represent about one third of all vertebral deformities.[13] If it is assumed that people with back pain associated with vertebral deformity come to medical attention, our data would suggest that this figure maybe an underestimate for women with deformities at the lumbar spine.

To our knowledge there are no data looking at the influence of relative position of deformity on self reported health. Our data suggest that in women deformities that are adjacent are more strongly and consistently linked with back pain and other adverse health outcomes than those that are non-adjacent. This might be explained by greater disruption to soft tissues in the surrounding area or, greater mechanical forces exerted on the surrounding facet joints. Ryan using SPECT scanning showed that pain associated with vertebral fractures was often linked with increased uptake of radioisotope in the adjacent facet joints.[14]

In contrast with the observations in women, in men site within the spine (thoracic/lumbar) did not seem to have an important influence on self reported health while those with non-adjacent deformities were more likely to report functional impairment. These apparent sex differences are not easily explained though may in part be related to differences in the pathogenesis of deformity in men and women. The prevalence of deformities in younger men is greater than in women, and the rate of increase with age is flatter than that observed in women.[7] We hypothesised this was attributable to an excess of non-osteoporotic deformities in the younger men—including traumatic fractures sustained during occupational or recreational activity. It is possible that the impact of such deformities on pain and function may be different from that associated with deformities caused by osteoporosis.

In summary, our findings suggest that the location of vertebral deformity in women, and in particular site, does influence the strength of the association with back pain and disability. Prospective studies are required to confirm these findings and clarify the temporal nature of the observed associations.

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Appendix

Activities of Daily Living Questions

1 Can you reach for example a book from a high shelf or cupboard?
2 Can you lift a heavy object of at least 10 kilo (e.g. a full suitcase) and carry it for 10 metres?
3 Can you wash and dry yourself all over?
4 Can you bend forward to pick up a small lightweight object from the floor?
5 Can you wash your hair over a washbasin?
6 Can you sit for one hour on a hard chair?
7 Can you stand continuously for 30 minutes (for example in a queue)?
8 Can you raise yourself in bed from a lying position?
9 Can you take socks or similar garments on and off your feet?
10 Can you bend down from a seated position and pick a small object at the side of your chair?
11 Can you lift a box containing 6 litre bottles of liquid onto a table?
12 Can you run 100 metres fast without stopping in order that you can catch a bus?

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