MEDICAL PRACTICE

Occasional Review

Scoliosis in the community

ROBERT A DICKSON

Abstract

Screening for scoliosis at schools has become more and more popular despite the lack of knowledge concerning the clinical course of idiopathic scoliosis. An epidemiological study of 5303 schoolchildren showed three types of scoliosis in the community: (1) pelvic tilt scoliosis (an inconsequential deformity caused by an inequality in the length of the legs but accounting for almost 40% of curves detected); (2) spinal scoliosis (a minor asymmetry of the spine in the coronal plane that tends to remain static or to resolve and which may be normal in growing children, accounting for the remaining 60%); and (3) progressive scoliosis (10% of the spinal scolioses measuring 10° or more that progress by 5° or more a year). Progressive scoliosis resembles idiopathic scoliosis because in girls with right thoracic curves the potential for progression is appreciable. Until the natural history is better established growing awareness in the community of spinal deformity should help earlier detection, and screening should be directed towards providing subjects for further epidemiological work.

Introduction

Screening for scoliosis was first performed in the early 1940s to detect paralytic spinal deformities resulting from the last poliomyelitis epidemics.[1] Attention was directed to idiopathic scoliosis 20 years later, and since then screening has mushroomed and gained worldwide enthusiasm. From the United States to Japan and Hungary to Canada screening is going on apace—in some countries it is even compulsory.[2-20] By rapid crude visual examination as many as 25% of normal adolescents appear to have a scoliosis, yet only two per thousand ever achieve a curve magnitude of 20°, for which treatment is usually recommended. Interestingly, they have all been regarded as being cases of idiopathic scoliosis.

Some sense was recently injected into this problem when the Oxford Scoliosis Study Group showed that as many as 40% of spinal deformities in people in the community were minor, non-progressive, lumbar scolioses secondary to a tilt of the pelvis caused by an inequality in the length of the legs (pelvic tilt scoliosis).[21] Of the remaining 60%, which at least appeared to be due to asymmetry of the spine (spinal scoliosis), only one fifth showed evidence of progression and therefore resembled true idiopathic scoliosis. Accordingly, a large scale epidemiological survey of more than 5000 adolescents in one community has been performed that sought to clarify what idiopathic scoliosis really is and what factors favour progression.

Patients and methods

Altogether 5303 schoolchildren (2613 girls and 2690 boys aged 10-14) were screened for a spinal deformity by an experienced senior physiotherapist who examined each child standing and leaning forward. Those with visual evidence of asymmetric trunk topography had a low dose posteroanterior spinal x ray examination.[22] From these films the site of the curve—that is, the position of the apical vertebra—and the direction—that is, the side to which the convexity of the curve was directed—were recorded. The magnitude of the curve was determined using Whittle's adaptation[23] of Cobb's method.[24] The prevalence rate of scoliosis in the community, particularly for the two major subgroups of pelvic tilt scoliosis and spinal scoliosis, was then analysed using these variables.

The 150 children with curves measuring 10° or more were then carefully examined to exclude a concomitant musculoskeletal condition. Radiographs were taken again at six and at 12 months. The magnitude of the curve was recorded from these follow up films and progression

Department of Orthopaedic Surgery, St James's University Hospital, Leeds LS9 7TF

ROBERT A DICKSON, CHM, FRCS, professor and head of the department of orthopaedic and traumatic surgery, University of Leeds

(an increase by 5° or more) or regression (a reduction by 5° or more) determined.

Statistical analysis was by the χ^2 test, Fisher's exact test, and the binomial two-tailed test.

Results

Table I shows the prevalence rate of all scolioses and the proportions of children with spinal and pelvic tilt scoliosis according to the size of the curve. The prevalence rate of scoliosis was almost 15%, with pelvic tilt scoliosis representing almost 40% of scolioses of 5° or more.

TABLE I—*Prevalence of all scolioses and the proportions of children with spinal scoliosis (SS) and pelvic tilt scoliosis (PTS)*

Curve size (degrees)	No	Prevalence all (%)	Proportions	
			SS (%)	PTS (%)
<5	241	4·5		
5–9	377	7·1	57	43
10–14	105	2·0	69	31
15–19	32	0·6	75	25
>20	13	0·2	92	8
Total	768	14·4	61	39

As the magnitude of the curve increased so the proportion of children with spinal scoliosis increased and the proportion with pelvic tilt scoliosis diminished reciprocally. Only two children per thousand screened had a curve magnitude of 20° or more, and only one of these had a pelvic tilt scoliosis (this was because the legs were extremely unequal in length and treatment had never been sought).

Table II shows the prevalence rate of scoliosis of 5° or more in relation to the sex of the children. The prevalence rate was significantly higher for girls for all scolioses ($p < 0·01$) and for spinal scoliosis ($p < 0·01$). Furthermore, for all scolioses and for spinal scoliosis the proportion of girls with curves of 15° or more was significantly greater than that of girls with curves measuring 5° to 9° ($p < 0·01$). The proportions of girls and boys with pelvic tilt scoliosis were not significantly different overall or at any magnitude of curve ($p > 0·05$).

Table III shows the site of the curve. Almost half of all scolioses were in the lumbar region, nearly twice as many as in the thoracic or thoracolumbar regions ($p < 0·001$). This significant preponderance of lumbar curves was lost with curves of 15° or more ($p > 0·05$). For spinal scoliosis, however, most curves were in the thoracic region ($p < 0·001$), but again significance was lost with curves of 15° or more ($p > 0·05$). The lumbar curve occurred most often in pelvic tilt scoliosis ($p < 0·001$), as would be expected in curves caused by a tilt of the pelvis.

Table IV shows the direction of the curve. Spinal scoliosis was more frequently left sided, thoracic ($p < 0·05$), thoracolumbar ($p < 0·01$), and lumbar ($p < 0·001$). The left side predominated in curves of 5°-9° in the thoracic ($p < 0·05$) and thoracolumbar regions ($p < 0·01$) but was not significant in curves of 10° or more ($p > 0·05$), whereas the left side was significant with curves of 15° or more in the lumbar region ($p < 0·05$). In pelvic tilt scoliosis, however, curves to the right and left sides were equally represented. When the direction of the curve was analysed in relation to the sex of the children there was no difference in left sided preponderance for thoracolumbar or lumbar curves. In the thoracic region, however, left sided preponderance was observed only in boys ($p < 0·01$), while in girls the proportions with right and left sided curves were not significantly different ($p > 0·05$).

No progression or regression occurred in the children with pelvic tilt scolioses. Ten per cent of spinal scolioses progressed and 18% regressed. None of the curves in a particular site progressed or regressed significantly ($p > 0·05$), nor were thoracolumbar or lumbar curves in girls or boys or on the right or left side associated with progression or regression ($p > 0·05$). For thoracic curves, however, progression tended to be associated with right sided curves and regression with left sided curves. Furthermore, the progression of right thoracic curves was significantly more common in girls than boys ($p < 0·01$).

TABLE II—*Prevalence of scoliosis and sex of children*

Curve size (degrees)	All		Girl:boy ratio	Spinal scoliosis		Girl:boy ratio	Pelvic tilt scoliosis		Girl:boy ratio
	Girls (%)	Boys (%)		Girls (%)	Boys (%)		Girls (%)	Boys (%)	
5–9	7·7	6·6	1·2:1	4·5	3·6	1·3:1	3·1	3·0	1·0:1
10–14	2·7	1·3	2·1:1	2·0	0·8	2·5:1	0·8	0·5	1·6:1
15–19	1·0	0·3	3·3:1	0·7	0·2	3·5:1	0·2	0·1	2:1
>20	0·5	0	—	0·5	0	—	0·04	0	—
Total	11·9	8·2	1·5:1	7·7	4·6	1·7:1	4·14	3·6	1·2:1

TABLE III—*Site of curve*

Curve size (degrees)	All				Spinal scoliosis				Pelvic tilt scoliosis			
	No of curves	Thoracic (%)	Thoracolumbar (%)	Lumbar (%)	No of curves	Thoracic (%)	Thoracolumbar (%)	Lumbar (%)	No of curves	Thoracic (%)	Thoracolumbar (%)	Lumbar (%)
5–9	394	24	26	50	232	40	38	22	162	0	9	91
10–14	122	30	23	48	89	40	26	34	33	0	15	85
15–19	34	26	32	41	26	35	35	31	8	0	25	75
>20	17	36	24	41	16	38	25	38	1	0	0	100
Total	567	25	26	49	363	40	34	26	204	0	11	89

TABLE IV—*Direction of curve*

Curve size (degrees)	Thoracic			Spinal scoliosis: Thoracolumbar			Spinal scoliosis: Lumbar			Pelvic tilt scoliosis		
	No of curves	Right (%)	Left (%)	No of curves	Right (%)	Left (%)	No of curves	Right (%)	Left (%)	No of curves	Right (%)	Left (%)
5–9	93	38	62	89	33	67	50	28	72	162	50	50
10–14	36	47	53	23	30	70	30	43	57	33	52	48
15–19	9	33	67	9	22	78	8	—	100	8	25	75
>20	6	67	33	4	75	25	6	—	100	1	100	—
Total	144	41	59	125	34	66	94	29	71	204	50	50

Discussion

Screening has been defined as "the presumptive identification of unrecognised disease or defect by the application of tests, examinations, or other procedures which can be applied rapidly."[25] Screening tests sort out apparently well people who have a disease from those who probably do not, and a prerequisite for this is that the clinical course of the condition should be known.[26] It is extraordinary that hundreds of thousands of children throughout the world have been subjected to a crude visual examination of the spine to identify asymmetry, which is supposed to be idiopathic scoliosis, whatever that condition is and however it behaves. When as many as a quarter of apparently normal children have visual evidence of spinal asymmetry in the coronal plane by this crude test then substantially more—possibly all children—would show evidence of asymmetry with a more sensitive test. This supports the view of anatomists two centuries ago that there is a scoliosis in every spine, albeit of small magnitude.[27 28] Indeed, a scoliosis surgeon, given an *x* ray film and a protractor, could find a scoliosis somewhere in any spine. When likened to screening for breast cancer we are screening for the presence of the breasts as it were, and there is nothing on examination of the spine akin to the underlying pathological breast mass. That almost 15% of normal children in this study had spinal asymmetry yet only two per thousand had a severe curve clearly shows that other important factors superimposed on a lateral curvature of the spine make it an idiopathic scoliosis.

An important diluting factor is the presence of pelvic tilt scoliosis due to an inequality in the length of the legs, which accounts for almost 40% of curves detected and which is manifestly not idiopathic scoliosis. The even female to male sex ratio, the diminishing prevalence with the magnitude of the curve, and the site being always low down in the spine and favouring no particular direction not increasing in size account for the high proportion of irrelevant lumbar curves that so typifies "schooliosis." The hitherto unrecognised contribution of pelvic tilt scoliosis has made interpretating the results of other screening studies extremely difficult, helped by a lack of awareness of the definition of common epidemiological terms, "incidence" and "prevalence" appearing to be freely interchangeable words of the same meaning. The high prevalence rate of pelvic tilt scoliosis is also important in relation to radiation dosage. In screening programmes any child with visual evidence of spinal asymmetry promptly undergoes radiography by conventional techniques. Thus far only two groups have sought to protect these children by reducing radiation dosage to a minimum.[22 29]

When pelvic tilt scoliosis has been identified and then eliminated attention may be directed towards scoliosis that is at least inherent to the spine—spinal scoliosis—where the characteristics of some curves begin to resemble idiopathic scoliosis. Girls predominate, particularly among children with bigger curves, and the thoracic region is the commonest site. Even so, although there are more left sided curves in the lumbar region in both "schooliosis" and idiopathic scoliosis, there are still more left thoracic curves in people in the community in contradistinction to idiopathic scoliosis. Ninety per cent of spinal scolioses either remain static or regress. The 10% that progress resemble true idiopathic scoliosis, with right thoracic curves in girls showing a real potential for progression.

Thus there seem to be three types of scoliosis in the absence of any musculoskeletal disease or congenital spinal anomaly. Pelvic tilt scoliosis is due to an inequality in the length of the legs. Spinal scoliosis probably reflects irrelevant coronal plane asymmetry of the spine in normal healthy children. Idiopathic scoliosis is by far the least prevalent but by far the most important. It is the 10% of spinal scoliosis that is progressive, and thus right thoracic curves in girls demand the closest scrutiny. Clearly other factors are important, and recent evidence suggests that while asymmetry of the spine in the coronal plane is so common as to be normal, asymmetry of the spine in the median sagittal plane in the nature of a lordosis at the apex of the curve is the essential lesion of idiopathic scoliosis.[30] As much attention should therefore be directed towards viewing the spine from the side as from the front or back.

While it is disturbing that many children with progressive scoliosis go untreated because they are not detected[31] and that the magnitude of the curve of those who do present clinically is often too great to allow conservative treatment,[32] it is clear that screening at school for scoliosis as it is practised does not primarily detect idiopathic scoliosis. It is an enormous waste of time, energy, and money of an already overstretched establishment, not to mention the hazards of taking radiographs of vast numbers of children who do not have idiopathic scoliosis for the benefit of the small number who do. If the results of the many reported studies had focused more on clinical course, and therefore been true epidemiological surveys we would have been much nearer having a prerequisite for a screening programme. Fortunately, where screening has been performed the magnitude of the curve in children at presentation has noticeably dropped, so that more children may have the benefit of effective conservative treatment.[33] This has not been due to the screening directly, since only small numbers of the population at risk have been examined, but is due to greater awareness in the community in general of scoliosis, and this is where resources should be directed until more is known about this complex condition to which the term idiopathic is singularly appropriate.

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References

1 Lonstein JE. Screening for spinal deformities in Minnesota schools. *Clin Orthop* 1977;**126**:33-42.
2 Kane WJ, Moe JH. A scoliosis-prevalence survey in Minnesota. *Clin Orthop* 1970;**69**:216-8.
3 Strayer LM. The incidence of scoliosis in the post-partum female on Cape Cod. *J Bone Joint Surg* 1973;**55A**:436.
4 Sells CJ, May EA. Scoliosis screening in public schools. *Am J Nurs* 1974; **74**:60-2.
5 Segil CM. The incidence of scoliosis in the Bantu and white population groups in Johannesburg. *J Bone Joint Surg* 1974;**56B**:393.
6 Golomb M, Taylor TF. Screening adolescent schoolchildren for scoliosis. *Med J Aust* 1975;**2**:761-2.
7 Brooks HL, Azen SP, Gerberg E, *et al.* Scoliosis: a prospective epidemiological study. *J Bone Joint Surg* 1975;**57A**:968-72.
8 Span Y, Robin G, Makin M. The incidence of scoliosis in schoolchildren in Jerusalem. *J Bone Joint Surg* 1976;**58B**:379.
9 Lonstein JE, Winter RB, Moe JH, *et al.* School screening for the early detection of spine deformities. *Minn Med* 1976;**59**:51-7.
10 Inoue S. Moire topography for the early detection of scoliosis and evaluation after surgery. *Orthopaedic Transactions* 1978;**2**:76.
11 Abbott EV. Screening for scoliosis: a worthwhile preventive measure. *Can J Public Health* 1977;**68**:22-5.
12 Flynn JC, Riddick MF, Keller TL. Screening for scoliosis in Florida schools. *J Fla Med Assoc* 1977;**64**:159-61.
13 Newman DC, DeWald RL. School screening for scoliosis. *IMJ* 1977;**152**: 31-4.
14 Bellyei A, Czeizel A, Barta O, Magda T, Molnar L. Prevalence of adolescent idiopathic scoliosis in Hungary. *Acta Orthop Scand* 1977; **48**:177-80.
15 Ascani E, Salsano V, Giglio G. The incidence and early detection of spinal deformities. *Ital J Orthop Traumatol* 1977;**3**:111-7.
16 O'Brien JP, van Akkerveeken PF. School screening for scoliosis. Results of a pilot study. *Practitioner* 1977;**219**:739-42.
17 Adair IV, Van Wijk MC, Armstrong GWD. Moire topography in scoliosis screening. *Clin Orthop* 1977;**129**:165-71.
18 Rogala EG, Drummond DS, Gurr J. Scoliosis: incidence and natural history. *J Bone Joint Surg* 1978;**60A**:173-6.
19 Smyrnis PN, Valavanis J, Alexopoulos A, Siderakis G, Giannestras NJ. School screening for scoliosis in Athens. *J Bone Joint Surg* 1979;**61B**: 215-7.
20 Burwell RG, James NJ, Johnson F, Webb JK. The rib hump score: a guide to referral and prognosis? *J Bone Joint Surg* 1982;**64B**:248.
21 Dickson RA, Stamper P, Sharp AM, Harker P. School screening for scoliosis: cohort study of clinical course. *Br Med J* 1980;**281**:265-7.

[22] Ardran GM, Coates R, Dickson RA, Dixon-Brown A, Harding FM. Assessment of scoliosis in children. Low-dose radiographic technique. *Br J Radiol* 1980;**53**:146-7.
[23] Whittle MW, Evans M. Instrument for measuring the Cobb angle in scoliosis. *Lancet* 1979;i:414.
[24] Cobb JR. Outline for the study of scoliosis. In: Edwards JW, ed. *Instructional course lecture*. Vol 5. Ann Arbor, Michigan: American Academy of Orthopaedic Surgeons, 1948:261.
[25] Commission on Chronic Illness. *Chronic illness in the United States*. Vol I. Cambridge, Massachusetts: Harvard University Press, 1957.
[26] Whitby LG. Screening for disease. Definitions and criteria. *Lancet* 1974; ii:819-22.
[27] Sabatier. *Traite complete d'anatomie*. Paris: 1777. Quoted by A Farkas.[28]
[28] Farkas A. Physiological scoliosis. *J Bone Joint Surg* 1941;**23**:607-27.
[29] De Smet AA, Fritz SL, Asher MA. A method for minimising the radiation exposure from scoliosis radiographs. *J Bone Joint Surg* 1981;**63A**:156-8.
[30] Dickson RA, Lawton JO, Archer IA, *et al*. Combined median and coronal plane asymmetry—the essential lesion of progressive idiopathic scoliosis. *J Bone Joint Surg* (in press).
[31] Nachemson A. A long-term follow-up study of non-treated scoliosis. *Acta Orthop Scand* 1968;**39**:466-76.
[32] Belstead JS, Edgar MA. Early detection of scoliosis. *Br Med J* 1978;ii: 937-8.
[33] Torell G, Nordwall A, Nachemson A. The changing pattern of scoliosis treatment due to effective screening. *J Bone Joint Surg* 1981;**63A**:337-41.

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Letters to a Young Doctor

Applying for jobs

PHILIP RHODES

You cannot get the job you want unless you get on the shortlist for interview, and to do this you need the right experience and the right qualifications. These, of course, vary a great deal according to the grade of post that you are applying for. Nevertheless, do not be too quick to decide that you are ineligible. It is up to the shortlisting committee to decide on the basis of your application whether you might be suitable.

But do not waste everyone's time—including your own. If you do not qualify on all ordinary criteria for the post then do not apply. For nearly all posts in the National Health Service at all levels, and certainly in the most desirable places, hospitals, and practices, there is now an enormous number of applications. So many of the applicants are of high quality that for those who have to prepare a shortlist it becomes a nightmare as to how to do it. Obviously, one looks for good or outstanding qualities, but in the nature of things these will be comparatively rare. Few of us stand out from the crowd when it is of high calibre, as in the case of doctors. So apart from looking for positive qualities one has to look for negative ones too.

You can imagine that in one way or another the people preparing a shortlist have three categories into which they put the applicants. In one small pile are those whom the panel ought to see, since they are very suitable, on paper at least. In the next pile are doubtful ones. And in the third pile are those rejected on the first round. Among these are the applications that are appallingly presented. The person who presents a bad application is thoughtless and slovenly and has not considered its importance to himself nor the difficulties of those who have to prepare a shortlist. Their time is short, and they assume that he who cannot be bothered to think about his application is likely to be careless in the job too. The quickest way to have your application put into the discard file is to prepare it badly and write it out in spidery longhand, cramming information into the boxes provided on application forms. It will then be too difficult to read and to abstract the relevant information about you.

University of Southampton, Southampton
PHILIP RHODES, MB, FRCS, professor of postgraduate medical education, and dean of graduate medicine for the Wessex region

Use the form provided

When the advertisement for the job tells you that there are application forms, send for one. If for any reason time is too short to send for the form because the closing date is too near, send in a typewritten application in the form suggested here with a typewritten covering letter explaining why you have not enclosed the formal application form.

Look at the application form carefully. In applying for pre-registration or senior house officer posts there may be plenty of room for you to enter your qualifications and experience under the various headings in the appropriate boxes. If so, use them. Have the entries typewritten by an expert. Use your own handwriting only if your calligraphy is first-class. Fill in all the boxes even if the entry is nil—that word can be used or a short line drawn. It shows that you have looked at the form, and it allows the reader to skim rapidly through it. Be careful about the layout of the information to make it as easy as possible for the reader to get the maximum information about you in the shortest possible time. There needs to be judicious use of capitals, headings, indentations, underlining, and abbreviations. This layout is very important. It must be neat, tidy, succinct, and accurate.

If your experience and the jobs you have done, together with dates and places, will not easily fit into the form, then have your application typed on separate sheets of good quality white A5-size paper on one side only. This will be the same size as the form and fits in with the size of the other application forms, making a neater pile so that the reviewer does not have to scrabble about with odd sizes that fall out. You can use the form as the top sheets of your total application. You may be able to fill in the boxes on the front page with such things as your name, marital state, nationality, medical school, qualifications, and the job being applied for. In other boxes you can have typewritten the words "see attached sheet." Do not duplicate information, except for those just mentioned, on the form and on the attached sheets. That just wastes the time of the reader. Your object is to impress him with your thoughtfulness, for he may then get the impression that you will have this characteristic in your work if you should be appointed.

The attached sheets should be headed in the form "Application for the Post of....." It may be best to have this as a separate sheet, which is usual in applications for consultant