Imagine that you have just made an incidental first diagnosis of a 20 degree idiopathic scoliosis in an 18 year old young woman. She has not suffered any back pain to date, but she and her parents ask you what is the likelihood that she will suffer with back pain later in life.

Your answer may be given relying on what you have been taught, the views of a more experienced colleague or your own experience. Each of these methods may be quite valuable but they are all subject to biases.

So, what are the alternatives? You decide to read your text books but are unable to find a satisfactory answer to the problem, in fact you discover that the texts say nothing about the question that is based on any scientific research. You decide (correctly) to go to the nearest Biomedical library and do a literature search to answer the question. The use of the current literature to answer clinical questions with scientific evidence can be termed “evidence based chiropractic”.

Now for those who do not have the time to travel to such a library, medical (eg. Medline) and complementary medicine databases (eg. Chirolars) are now available on-line. They will give you information up to abstract form, and it is hoped that as the “information super-highway” is constructed full text articles will be available.

You travel to library and with the help of a librarian you conduct a Medline search from 1966-1994 using the key indexing terms scoliosis, spinal curvature with low back pain, backache, low backache, back pain, pain. This initially reveals 46 papers of which 9 were directly related to the question. Science Citations, Sesame 2 and Index Medicus were also reviewed but offer no new information. You also subscribe to the journal “Spine” and this proves fruitful with the discovery of a very recent paper on the question.

You find that studies of the natural history of scoliosis and its epidemiology vary on the question of its association with back pain. Several studies do suggest that back in scoliotic adults is more severe and more prolonged than non-scoliotic subjects (1,2,3,4,5,6) while other studies conclude that the incidence of back pain in scoliotic subjects is similar to the general population (2,6,7,8,9).

To ascertain whether scoliosis increases the likelihood of back pain in adulthood you select three of the papers for review (2,5,6). These papers specifically address the question asked, they are representative of the total papers obtained and were considered the most relevant and methodologically sound.

The problem now arises how do I assess the relative scientific worth of these papers, so that I can answer the question asked of me?

Fortunately, you call a colleague who recommends an outstanding test which includes methodological criteria for the critical assessment of an article on prognosis (10). You read the relevant chapter (pages 173-85) and decide to apply the criteria to the three articles you have selected.

The questions that Sackett et al (10) recommend you ask are:

1. Was an “inception cohort” assembled?

Failure to assemble a cohort of patients who are at an early and uniform point in the course of their disease (in our case scoliosis) usually constitutes a major flaw in prognosis studies.

2. Was the referral pattern described?

Where did the patients come from? The pathways by which they entered the study should be described. Four types of bias are associated with referral pathways. If the research was carried out at a world renown scoliosis centre of a major children’s hospital then it is likely that the cases will be different to those seen by you in clinical practice. This is known as centripetal bias. If the specialists at this centre only admit certain types of scoliosis cases or and above less mundane ones then popularity bias supervenes. Regardless of this factor specialty units such as this often exclude certain subsets of patients with the condition from the research which introduces referral filter bias. Finally, sometimes certain groups within the community may not have access to facilities which can diagnose the condition (scoliosis), and if this group is precluded from the study the result is diagnostic access bias. In our example females who belong to a certain ethnic or religious group may not be able to afford transport to the research centre.
3. Was complete follow up achieved?

All subjects in the trial should be accounted for at the beginning and at the end of the trial. Drop outs may have occurred for very important reasons, such as adverse or beneficial effects.

4. Were objective outcome criteria developed and used?

The instruments of measurement used to decide what state the patient was in should be reliable, valid and able to be implemented in your own practice. Eg. The measurement of Cobb angles.

5. Was the outcome assessment blind?

The personnel who measure outcomes should be “blind” to other features that these subjects have. For instance, if the clinician conducting the measurements knows that the subject has scoliosis they may search harder for symptoms, this is known as diagnostic-suspicion bias. Also, chiropractors who interpret x-rays of a subject may have their judgments dramatically influenced by some initial knowledge of the case (expectation bias).

6. Was adjustment for extraneous prognostic factors carried out?

Extraneous factors in our example such as degeneration, previous injury, co-existing pathology could all affect the outcome. Such factors need to be accounted for and statistical adjustments made. For every such factor there should be at least 10 patients in the group.

For the purposes of this article I have performed such an appraisal of the three articles and it appears hereunder:

ARTICLE 1
Kostiuk (6). The Incidence of Low-Back Pain in Adult Scoliosis.

Summary:
The authors studied 5000 intravenous pyelograms of adults over the age of 20, taken over a 2 year period. From their records and x-rays they attempted to ascertain the incidence of scoliosis and pain patterns in individuals with curves >10°. A total of 189 were found to have a curve >10°. They located 159 of this group and found that 94 had back pain. The authors claim that this was comparable to the incidence in the local population (substantiated by a personal communication!) and to a group of 100 IVP subjects without scoliosis whom they also interviewed but provided no data on. They did also state that age bore no relationship to pain but concluded that as the degree of curve increased so did the severity of pain, particularly curves >45°.

1. Was an inception cohort assembled?

No. The patients were identified retrospectively from 5000 IVP x-rays. They were of different ages and therefore were not at a uniform point in the course of the “disease” at inception.

Diagnostic criteria: A minimum of 10° of curvature (with rotation) was chosen as the selection criteria. However, these films were taken supine and as such were probable underestimates of curve. The method of mensuration (eg. Cobb) was not revealed.

Disease severity: This was tabulated in 3 groups: 10-24°, 25-44°, and >45°.

Co-morbidity: An attempt was made to relate other x-ray changes such as degeneration to pain. However, the data were inadequate and I was unable to make any reasonable assessment.

Demographic details: The relationship of occupation and pain was explored, as was age and pain. The occupational strata were given as light, medium and heavy. However, the description of the categories was subjective. No information on general health, gender, socio-economic status or psychological state were given. There were no other demographic data provided.

2. Was the referral pattern described?

Only that we know that 5000 subjects had undergone IVP’s. No other information is supplied. We might assume that these patients had suspected renal dysfunction which raises the issue of back pain from renal causes in the study group. There was no mention of this in the paper and introduces a possible selection bias. Centripetal and population bias were not relevant. Diagnostic access bias was certainly possible as these patients were presumably able to finance their renal investigations and therefore may not have been from a poor group. The authors claim that the study is population based, however I disagree, the subjects were selected because of a second sampling factor ie. They had an IVP.
3. Was complete follow up achieved?

No. Thirty of the 189 with scoliosis were not located. No data on the severity of their curves is given or their age. The effect of this is indeterminate. However, if the 30 are added in a best and worst case scenario it certainly would alter the results. The general clinical status of both those in the trial and those lost to follow up is unknown.

4. Were objective outcome criteria developed and used?

a. The degree of pain was provided in 3 subjective categories. This was adequate and other measures of pain and function should have been used. It also appears that the authors simply measured pain in a cross-sectional fashion. The subjects either had pain or they did not. This does not take account of attacks of pain over time, nor the frequency or duration of pain.

b. Age stratification by decades for pain was provided and this demonstrated an increase of back pain prevalence with age until 60 then a decrease. There was no comparison with control group. In fact there was no data provided on the control at all!

c. The categorisation of the degree of pain was reproducible.

5. Was outcome assessment blind?

Can’t tell. It is unclear who conducted the interviews, introducing the possibility of diagnostic suspicion and expectation bias.

6. Was adjustment for extraneous factors carried out?

There was a partial attempt to canvass 3 confounding factors: age, occupation and other x-ray findings. Of these only age was performed well. Many other factors may have influenced the results. These have been cited above under inception cohort. There was no multi-variate analysis.

Conclusion:
This study was clever in that it used an existing data bank of IVP x-rays to identify a group of scoliotic patients. However, there were many methodological flaws in the study (particularly the absence of an adequate control group) which leaves the authors conclusions in doubt.

ARTICLE 2
Jackson (2). Incidence and Severity of Back Pain in Adult Idiopathic Scoliosis.

Summary:
The authors state that the main purpose of the study was to determine:

1) Incidence and severity of back pain in a group of adult patients with idiopathic scoliosis and in a comparable group of controls without scoliosis.
2) The course of back pain in adults with and without scoliosis.
3) Severity of pain in idiopathic scoliosis related to age and the nature of the curve.

This retrospective study involved 197 scoliotic adults referred to a specialist centre for opinion. Of these 101 had a chief complaint of pain. All were assessed by physicians and by a self administered questionnaire, the results of which were compared. 180 age/sex matched controls were also assessed in a similar fashion.

The results show a similar “incidence” (actually prevalence) of back pain in cases and controls, but greater severity and duration of pain in the cases. This increases with age and spinal curvature independently. They state that the clinical course of adult scoliosis was pain persistence and progression in over 80% of patients studied.

1. Was the inception cohort assembled?

No. The authors chose a retrospective random sample of 500 scoliotic patients seen at their centre over a ten year period. Of these 197 were older than 18 and qualified as adults with scoliosis. There was no discussion of when their scoliosis was identified.

Diagnostic criteria: Scoliosis mensuration methods were described as were exclusions from the study.

Disease severity: Scoliosis and pain were graded at the commencement of management at the centre.

Co-morbidity: This was not addressed well. Co-existing degeneration of the spine was not measured for cases or controls, nor was general health, history of back pain or psychological status.

Demographic details: Age and sex were used. There was no reference to other details such as occupation and socio-economic status.
2. Was the referral pattern described?

The scoliotic group were referred for assessment to this tertiary centre because of pain and/or curve. The authors acknowledge that the scoliotic group would therefore contain a predominance of painful patients in their group. They try (erroneously) to “control” for this by having patients fill out self-administered pain questionnaires.

I believe the scoliotic group selection would have been subject to centripetal, popularity, referral filter and diagnostic access bias. This should necessarily qualify the authors conclusion regarding generalisability. The authors did not conclude in this manner but chose to generalise their conclusions to all scoliotic subjects.

3. Was complete follow up achieved?

Of the 101 painful scoliotics. Only 75% actually completed the self administered pain questionnaire. The impact of this is difficult to assess as the questionnaire was one of two methods of pain measurement. The physicians assessment was also used and the authors provide evidence that this matches the patients own assessment. So, I would conclude that the 75% questionnaire completion rate was a concern, but not overly significant.

4. Were objective outcome criteria developed and used?

The authors used:

1) Physicians graded assessment of the patients pain on a 6 point scale.
2) Patients self-assessment using the same scale.
3) Measurement of spinal curvature.

The six point scale was a mixture of pain level and disability. As this was the 1970’s I suspect that there were few validated instruments of measurement available. I believe the criteria used were probably reproducible, but there accuracy is unknown.

5. Was outcome assessment blind?

No. Although a self administered questionnaire was used. True blind assessment was not. Diagnostic suspicion and expectation bias must be suspected, however the self administered questionnaire matched the physicians evaluation, so this tends to temper my fear on these biases.

6. Was adjustment for extraneous factors carried out?

Adjustment was carried out for age, sex and degree of curvature. But not for other factors such as spinal degeneration, back pain history, general health, SES, occupation and psychological state.

Conclusion:
This study was reasonably well conducted. There were a number of concerns particularly in the selection of cases, the potential for confounding and the erroneous generalisation to the whole scoliosis population. However, the general conclusions still appear plausible for a tertiary referral centre.

ARTICLE 3
Mayo NE (5). The Std. Justine Adolescent Idiopathic Scoliosis Cohort Study. Part 3. Back Pain.

This study is published in three parts. The first part deals with selection of cases and controls. The methods section is attached together with Part 3 on Back Pain.

Summary:
The objectives of the study were to determine the health and well-being of persons with AIS more than 10 years after referral. This was a retrospective cohort with a population based control group. Back pain was assessed with a postal questionnaire. 1476 AIS subjects responded out of a cohort of 2092.

The authors conclude that AIS subjects suffered significantly more back pain than controls. The pain was more intense, continuous, generalised and radiating, resulting in a considerable amount of disability and handicap in later life.

1. Was an inception cohort assembled?

This was a retrospective cohort and therefore difficulties are faced with cohort assembly. However, the authors have gone to great lengths to identify their cohorts and discuss potential confounding factors in its selection. The cohort were a broad age range of subjects, many of whom probably had scoliosis for many years at inception. The large number in the final cohort (1476) certainly assists with the power of the study.

Diagnostic criteria: Subjects must have had scoliosis, reached the age of 9 years, not have any other condition which would affect functioning in adulthood (not specified).
Disease severity: Degree of curve was measured by the Cobb method. The authors conducted a quality assurance study on the Cobb measurement and found good agreement.

Co-morbidity: The authors state that “other medical conditions” were noted in the histories but fail to elaborate. Presumably, the large sample size (cases and controls) together with other health matching data minimise the risk of this being a major factor.

Demographic details: These are quite extensive and include age, sex, height, weight, place of residence, family history, previous treatments, language spoken, recreation activity, marital status, education level, smoking status, alcohol and occupation.

2. Was the referral pattern described?
Yes. Ste. Justine Hospital was described as the largest tertiary care paediatric hospital in Quebec. Certainly, centripetal, popularity and referral filter bias were possible. The cases are likely to be the more severe ones referred to this centre and may not represent the general population of scoliosis subjects. Diagnostic access bias is also a possibility considering Canada’s vast size (?rural patients).

3. Was complete follow up achieved?
There were 2092 in the original cohort, 1858 subjects were traced and 1476 returned questionnaire. This represents 70% of the original cohort. The group that could not be traced are not discussed. However, the group that were traced and that did not respond were. This group were analyzed and found to have a preponderance of minor curves. This may suggest that they may not have had significant pain or interest to respond. In their results the authors did not find a “dose-response” for scoliosis and pain. They acknowledge that those with lesser curves (and possibly little pain) who did not respond may have biased the results. The authors cover the non-responder issue very well.

4. Were objective outcome criteria developed and used?
The authors used health measures including:
1) Back pain in the preceding year.
2) Frequency and duration of episodes.
3) Back pain at the time of completing the questionnaire (location, intensity, radiation, impact and function).
4) Two general health surveys (combined).
5) McGill Pain Questionnaire.
6) Oswestry LBP disability questionnaire.
7) Roland index.

Most of these were validated instruments. However, recall bias must be considered.

5. Was outcome assessment blind?
No. It was via self administered questionnaire. Self reporting introduces its own bias, possibly elevating the pain scores. Assessment of a random sample of cases and controls by blinded assessors and then comparison with the self assessment would have been preferable. This would not have eliminated diagnostic suspicion bias altogether, as scoliosis is often readily seen on examination.

6. Was adjustment for extraneous factors carried out?
Yes. Extensive statistical modeling was used for a host of potentially confounding factors, including age, sex, weight, smoking, general health, alcohol, occupation and even mortality.

Conclusion:
This study was extensive and impressive. The results are consistent with a number of other studies, except for the absence of a “dose-response” effect. This is discussed by the authors. The conclusions should have the caveat that they relate to scoliotic patients referred to a tertiary centre.

OVERALL CONCLUSION
So, you are now able to make the following overall conclusion and answer the question “Does idiopathic scoliosis increase the likelihood of back pain in adulthood”?

The evidence from these studies (particularly Jackson and Mayo) suggests that scoliosis increases the likelihood of back pain in adulthood. The Mayo study quantifies the odds ratio at about 2.79 for females (95% CI 2.3-3.39) and 2.06 (1.39-3.03) for males.

You are now able to offer an answer to your patient and her parents which accurately reflects current scientific opinion. One could put this into the following words “The chances of having back pain during adulthood are 2 to 3 times that of someone who does not have the condition”.

It should be noted that all three papers studied above were retrospective. A large prospective cohort study should be undertaken with matching controls to clear
up the outstanding issues of pain prevalence in scoliosis, dose-response and the generalisability of previous studies to the whole scoliosis population.

The method used above to answer a clinical question can be called “evidence based chiropractic”. It is the preferred method of answering clinical questions and will with time pervade every aspect of chiropractic practice and education. Once the fundamentals of using the databases and performing the critical appraisals are known the rest is practice. The formation of journal clubs will facilitate the learning of these techniques in current chiropractic practice while the revision of undergraduate teaching will allow new graduates to use the methods immediately.

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