# Screening for Idiopathic Scoliosis in Adolescents: A Brief Evidence Update for the U.S. Preventive Services Task Force

## Methodology

The search strategy for this brief update included MEDLINE®, Cochrane Library, and National Guideline Clearinghouse reviews for English-language articles published between 1994 and 2002 on new direct evidence of the benefits and harms of screening and treating adolescents for idiopathic scoliosis. The search was limited to randomized controlled trials (RCTs), meta-analyses, systematic reviews, well-designed observational studies, and editorials and commentaries concerning the critical key questions. Studies were excluded if they did not meet the specific inclusion criteria or were not relevant to a key question.

Search terms included *scoliosis, idiopathic scoliosis, mass screening, treatments,* and *population based.* The search terms were limited to adolescence, English language, and the years 1994 to 2002. *Scoliosis* and *idiopathic scoliosis* were MeSH terms that were exploded by the remaining terms. The search yielded 120 articles related to screening for and treatment of adolescents for idiopathic scoliosis. Only 16 articles directly addressed a critical key question, and only 1 was an RCT.

## Key Questions and Results

The key questions that follow are adopted from the standard Task Force key questions for a screening analytic framework.[3] This targeted review focused on the Task Force's key questions 1, 2, 3, and 5.

### 1. Is there new direct evidence that screening asymptomatic adolescents for idiopathic scoliosis leads to better health outcomes than not screening?

No studies addressing this question were identified.

### 2. Is there new evidence about the rate at which minor scoliosis progresses to a clinically significant form that causes health problems later in life?

A retrospective cohort study by Cordover et al[4] examined low back pain and the perception of handicap of non-surgically treated adolescents with idiopathic scoliosis (Cobb angle 20–55 degrees). Thirty-four of 65 patients (52%) answered a questionnaire pertaining to severity of pain, functional abilities, and perceived quality

Systematic Evidence Reviews serve as the basis for U.S. Preventive Services Task Force (USPSTF) recommendations on clinical prevention topics. The USPSTF tailors the scope of these reviews to each topic. The USPSTF determined that a brief evidence update was needed to assist in updating its 1996 recommendations on screening adolescents for idiopathic scoliosis.[1]

To assist the USPSTF, the RTI International-University of North Carolina Evidence-based Practice Center, under contract to the Agency for Healthcare Research and Quality (AHRQ), performed a targeted review of the literature published on this topic between 1994 and 2002. This brief evidence update and the updated recommendation statement[2] are available through the AHRQ Web site (http://www.preventiveservices.ahrq.gov) and in print through subscription to the *Guide to Clinical Preventive Services, Third Edition: Periodic Updates.* The subscription costs $60 and can be ordered through the AHRQ Publications Clearinghouse (call 1-800-358-9295 or e-mail ahrqpubs@ahrq.gov). The recommendation is also posted on the Web site of the National Guideline Clearinghouse™ (www.guideline.gov).

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of life. The same questionnaire was answered by 31 age- and sex-matched controls for comparison. The average time to follow-up was 22 years, and the average patient age at current follow-up was 36 years. No information was provided on how scoliosis was initially detected. The results showed a significant difference in back pain scores between the study group and the control group ($P$=0.0083). Thirty-five percent of the study group reported no back pain, and 68% of those in the control group reported no back pain. Severe back pain was reported in 9% of the study group, compared with 0% of the control group. Perception of handicap was comparable in both groups (no scores or $P$ values given).

The Ste-Justine retrospective cohort study[5] sought to compare the impact of idiopathic scoliosis during adolescence with its impact in adulthood by comparing 1,476 clinic-based patients (Cobb angles <20 to >40 degrees) more than 10 years after referral with an age- and sex-matched control group of 1,755 persons without idiopathic scoliosis. Patients were initially identified by chart review; 71% (1,476 subjects) returned a questionnaire. No information was provided on how scoliosis was initially detected. The results showed that women who had idiopathic scoliosis during adolescence had poorer overall perception of health than did women in the control group (odds ratio [OR] 1.19; 95% confidence interval [CI], 1.06–1.34); but men with idiopathic scoliosis during adolescence had the same overall perception of health as did men in the control group (OR 1.18; 95% CI, 0.93–1.49). Women with idiopathic scoliosis during adolescence also showed significantly greater difficulty performing physical activities than did women in the control group. Back pain in the past year was significantly higher in the study group (OR 2.14; 95% CI, 1.81–2.53) than in the control group.

## 3. How valid and accurate are screening tests for adolescents with idiopathic scoliosis?

A retrospective cohort study conducted by Yawn et al[6] evaluated the effectiveness of a community-based school scoliosis screening program. Two thousand forty-two children were screened annually from grades 5 to 9 and followed up until age 19. Ninety-two children (4.1%) were referred for further evaluation. The cumulative incidence of scoliosis for curves of more than 10 degrees in this population was 1.8% (95% CI, 1.2%–2.3%); for curves of at least 20 degrees, 1% (95% CI, 0.6%–1.5%); and for curves of 40 degrees and more, 0.4% (95% CI, 0.1%–0.6%). Of the entire study population, 0.4% received treatment for scoliosis. The positive predictive value of the scoliosis screening program was 0.05 (95% CI, 0.048–0.052). The number needed to screen was 448 for each child who received treatment.

A prospective cohort study in Greece[7] examined the prevalence of scoliosis in children aged 8–12 years who were enrolled in a school-based screening program. Of 21,220 children screened, 9.6% were referred for radiological examination. The prevalence of children with Cobb angles >10 degrees was 1.7%. Only 0.06% showed severe abnormalities (>20 degrees) and required treatment. Follow-up studies are planned to assess the impact of the screening program and of conservative treatment on the natural history of the disease.

A prospective cohort study from the Netherlands[8] examined whether the addition of an annual screening for scoliosis to the usual biennial health check-up would result in improved treatment outcomes (compared with the biennial health check-up alone). More than 30,000 students aged 10–14 years were screened and followed up for more than 3 years. The authors compared adolescents with idiopathic scoliosis detected through an annual school-based screening program (n=57) with a control group of adolescents with idiopathic scoliosis diagnosed outside of this annual screening (n=34). The results showed that adolescents who had more severe cases of idiopathic scoliosis were, for the most part, previously detected outside of this screening program (during prior school health checks). This annual school-based screening program did not detect a single case of idiopathic scoliosis that required surgery. The authors concluded that all patients needing treatment would be detected by the usual biennial

periodic health checks and that additional annual scoliosis screening was not warranted.

## 5. Is there new evidence that scoliosis treatments lead to better health outcomes if applied at an early stage?

We found only 1 RCT that addressed this critical key question. A randomized controlled trial from Saudi Arabia by El-Sayyad et al[9] examined the effects of exercise, exercise and Milwaukee brace, and exercise and electrical surface stimulation on idiopathic scoliosis. Thirty children between 6 and 16 years of age, who had progressive idiopathic scoliosis with moiré angles (an alternative to the Cobb method for assessing the angle of curvature) between 15 and 45 degrees, were enrolled in a 3-armed trial. Significant correlations between Cobb and moiré angle have been reported (r=0.60 to 0.90).[9,10] No information was provided on how scoliosis was initially detected. The outcome was a change in the moiré angle. The outcome was assessed by a blinded examiner with moiré topography at baseline and after 12 weeks of treatment. The results showed a statistically significant overall improvement of the moiré angle after 12 weeks of treatments for all 3 groups ($P$<0.05). No statistically significant difference was found between the treatment groups.

A summary of cohort studies and case series analyses that address this critical key question follows.

A Swedish retrospective cohort study by Danielsson et al[10] determined the long-term outcome, based on radiologic findings, of patients with idiopathic scoliosis (identified from the Göteborg Scoliosis Data Bank) who underwent surgical treatment or treatment with braces during adolescence compared with an age-matched population-based control group who were not treated with these interventions. A total of 142 patients who received surgical treatment and 110 patients who received brace treatment were enrolled. The average time for follow-up for surgically treated patients was 23 years and for brace-treated patients, 22 years. No information on how scoliosis was initially detected was provided. The deterioration of the curves was low in both groups, with a mean of 3.5 degrees for the surgically treated group and 7.9 degrees for the brace treated group ($P$<0.001). As a secondary outcome, the overall complication rate of surgical treatments was assessed and found to be low. Pseudarthrosis was found in 1.9% and flat-back syndrome was found in 2.6% of the surgically treated patients; 5.1% of surgically treated patients needed instrument-related re-operations. No difference in degenerative change was found between the group treated with surgery and the group treated with braces. However, there was a significant difference in radiologically detectable degenerative disc changes between the treatment group and the control group ($P$<0.0001).

A Swedish prospective, multi-national, multi-center cohort study[11] conducted by the Scoliosis Research Society followed 159 adolescent girls with idiopathic scoliosis until skeletal maturity or until progression in the curve of at least 6 degrees. Each participating center adhered to its preferred method of treatment. All patients (mean age 13 years) had an initial Cobb angle of 25 to 35 degrees. No information was provided on how scoliosis was initially detected. A treatment group of 39 patients received electrical stimulation and 120 patients were observed but received no treatment. No difference in outcome could be shown between patients who received electrical stimulation and those who were observed but not treated. No information is provided as to whether the examiners were blinded to which was the treatment group. A multivariate analysis showed that skeletal maturity was the most significant risk factor for the progression of the scoliotic curve ($P$<0.001). The model controlled for possible confounding variables.

A different arm of the Swedish study[12] examined 286 adolescent girls aged 10 to 15 years with idiopathic scoliosis curves ranging from 25 to 35 degrees. No information was provided on how scoliosis was initially detected. One intervention group received underarm braces (111 patients), a second group received nighttime surface electrical stimulation (46 patients), and a third group was followed with observation only (129 patients). Follow-up was conducted until the girls reached skeletal maturity or until there was an increase

in the curve of at least 6 degrees (the defined endpoint of failure). Survival analysis presented a highly significant difference ($P<0.0001$) in treatment with braces (success rate of 74% at 4 years) compared with electrical stimulation (success rate of 33% at 4 years) and observation only (success rate of 34% at 4 years). Treatment was considered successful if it prevented 6 degrees of increase or more in the scoliotic curve until the patients were 16 years of age.

A meta-analysis[13] examined the effectiveness of non-operative treatments of adolescents with idiopathic scoliosis. Data on 1,910 patients from 20 studies published between 1975 and 1995 were collected. All studies were observational studies, and only 1 included a control group. The authors assessed the qualities of the studies using a point system. No test of heterogeneity was administered. The criterion for failure ranged from 3 to 10 degrees of curve progression. Bracing for 23 hours per day was significantly more effective than any other treatment (weighted mean proportion, 0.92; $P<0.0001$). The weighted mean proportion of success was highest for the Milwaukee brace; scoliosis progressed in only 1% of patients who used the Milwaukee brace. Meta-analysis demonstrated no difference between bracing for 8 or 16 hours per day compared with no treatment.

## Summary

No direct evidence was found on the benefits and harms of screening adolescents for idiopathic scoliosis.

Two retrospective cohort studies show increased back pain in adults who had idiopathic scoliosis during adolescence, compared with those who did not, after long-term follow up.

One RCT,[9] 3 cohort studies,[10–11] and 1 case series meta-analysis[13] have compared various treatments for idiopathic scoliosis during adolescence. The quality of these studies is mixed, there is likely to have been inadequate adjustment for confounding, and the primary outcome examined was angle progression rather than health outcomes. Finally, none of these studies primarily involved people detected by screening.

## Recommendations of Professional Organizations

No changes were found. Recommendations from the Scoliosis Research Society can be accessed at http://www.srs.org. Recommendations from the American Academy of Orthopaedic Surgeons can be accessed at http://orthoinfo.aaos.org.

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AHRQ Pub. No. 05-0568-B
November 2004