SPINE Volume 33, Number 20, p 2160–2165
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# Adolescent Idiopathic Scoliosis and Exercising

## Is There Truly a Liaison?

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**Study Design.** Cross-sectional observational study.

**Objective.** Evaluation and comparison of the prevalence of adolescent idiopathic scoliosis (AIS) among 2 groups of patients (athletes and nonathletes) to determine whether athletic activities are related to the development of AIS.

**Summary of Background Data.** The potential association between AIS and exercising remains uncertain. The latter has often been considered as a therapeutic means and a causative factor of the former.

**Methods.** A group of 2387 adolescents (boys: 1177, girls: 1210, mean age: 13.4 years) was evaluated. All completed a questionnaire concerning personal, somatometric, and secondary sex characteristics, type, duration and character of daily-performed physical activities, and existing cases of AIS among relatives. Patients were classified into 2 groups according to their answers; "athletes" and "nonathletes." The groups were comparable as far as age, height, weight, onset of menstruation, family history of scoliosis, and side of handedness were concerned. Children underwent physical examination by 3 orthopedic surgeons who were unaware of their level of athletic activities. Children considered, by all, to be suspicious of suffering from scoliosis, underwent further radiographic evaluation.

**Results.** In 99 cases (athletes: 48, nonathletes: 51), AIS was radiographically confirmed (Cobb angle >10°). No statistically significant difference was found between athlete and nonathlete adolescents ($P = 0.842$), athlete and nonathlete boys ($P = 0.757$), and athlete and nonathlete girls ($P = 0.705$), as far as the prevalence of AIS was concerned. The mean value of the Cobb angle of the main scoliotic curve was not statistically different between male athletes and nonathletes ($P = 0.45$) and female athletes and nonathletes ($P = 0.707$). With the Cobb threshold reset at 20°, no statistically significant differences were detected either.

**Conclusion.** Our results demonstrate that systematic exercising is probably not associated with the development of AIS. Actively participating in sports activities doesn't seem to affect the degree of the main scoliotic curve either.

**Key words:** adolescent idiopathic scoliosis, exercising, adolescent idiopathic scoliosis and exercising, sports. **Spine 2008;33:2160–2165**

The actual cause(s) of adolescent idiopathic scoliosis (AIS) remain(s) unknown. Even though several theories have been proposed, and many factors have been associated with the development of AIS, the exact pathogenetic mechanisms and possible contributing factors that lead to its development, remain at the moment, more or less, unclear.[1–7]

The potential relation between AIS and exercising is rather vague. The latter has often been considered to be a causative factor of the former, especially among adolescent athletes who are engaged in certain athletic activities.[5–8] The high-repetition nature of competitive athletic activities[9] and the exercise-related exerted stress on the spine of professional adolescent athletes, starting in juvenility and exerted over many years in susceptible immature subjects, and also joint laxity, may also be associated with an increased incidence of AIS. Participating in competitive sports activities; however, has not been so far (positively or negatively) associated with the development of AIS in any large series study.

The aim of this study, was the assessment of the prevalence of AIS among athletes and nonathlete adolescents to determine whether an association between exercising and AIS exists.

## ■ Materials and Methods

This cross-sectional, observational, school screening study was approved by our Institution's Scientific Research Board and it was conducted between September 2005 and June 2006 in 5 secondary "athletic" schools in accordance with the World Medical Association Declaration of Helsinki of 1964 as revised in 1983 and 2000. The daily program and the curriculum of these schools are organized in a manner that helps athletes performing their daily training activities. Professional and nonprofessional athletes and nonathletes can be enrolled in these schools. The parents of all patients were informed about their children's participation in the study and gave informed consent.

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Acknowledgment date: September 27, 2007. First revision date: December 8, 2007. Second revision date: January 27, 2008. Third revision date: March 15, 2008. Acceptance date: March 18, 2008.

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work. No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

This study was conducted at the Orthopaedic Department, Aristotle University of Thessaloniki-Medical School, "Papageorgiou" General Hospital, Thessaloniki, Greece.

This study has been approved by the Institution's Review Board and was conducted in accordance with the World Medical Association Declaration of Helsinki of 1964, as revised in 1983 and 2000. After the patients' parents were fully informed, they consented that their children could participate in this study and that data concerning their children could be submitted for publication.

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The determination of the samples' necessary size was made according to the reported prevalence of AIS in groups of athlete and nonathlete adolescents.[5,8–11] Taking into consideration the fact that the prevalence of AIS has been reported to be rather high among athlete adolescents (6.9%–12%)[8,9] and especially among inhabitants of the geographical region that this study was performed (mean value of 2.9%, range 1.1%–5.7%),[10,11] our analysis demonstrated that with a sufficient power of 0.9 and $\alpha$ value of 0.05, to see a difference between 3% to 6% (nonathletes and athletes), at least 1000 adolescents had to be enrolled in each arm/group of the study.

All children underwent physical examination by 3 orthopedic surgeons that were unaware of their level of athletic activities. Athletes and nonathletes were observed in the standing erect position for asymmetries of the lateral contours of the trunk, shoulders, and scapulas. The "Adam's forward bending test" was performed to determine the existence of rib hump asymmetry, the length of the children's limbs was measured, and any signs of skeletal abnormalities or generalized illness were recorded. Children suffering from congenital scoliosis, scoliosis secondary to other disease, diagnosed with any skeletal abnormality that could interfere with the interpretation of the Adam's forward bending test (spondylolysis-spondylolisthesis, Scheuermann kyphosis), known endocrine disorders or legs' length discrepancy were excluded.

Children considered by all examiners to be suspicious of suffering from scoliosis underwent further radiographic evaluation (standard standing postero-anterior radiograph of the thoracic and lumbar spine-iliac crests included and true lateral radiograph of the thoracic and lumbar spine). A curve ≥10° (Cobb method) combined with rotational deformity of the involved vertebrae, was defined as AIS. The 10° threshold was chosen mainly because it is strongly supported by the literature.[6,10,12] However, to assess whether a higher threshold would have had any impact on the statistical comparison between the 2 groups, we decided to further analyze the cases of patients suffering from AIS with a curve ≥20°.

After their clinical examination, patients completed (assisted by their parents) a standard detailed questionnaire concerning personal, somatometric and secondary sex characteristics, side of handedness, a brief family report (aiming to reveal AIS cases among relatives), and participation in sports activities (practiced sport, membership in an athletic association/club, average weekly duration and years of practicing). Children were classified into 2 groups according to their answers; athletes and nonathletes. A child who actively, continuously, and systematically practiced a sport for at least 2 years before his/her participation in the study was considered as an athlete. Furthermore he/she had to follow a professional training schedule of at least 10 hours per week and be a member of an athletic association/club. Children who did not practice any sport at all, or did not systematically practice any sport, or did practice sports but only for self-recreation, were considered as nonathletes. Children being in the "gray zone" between athletes and nonathletes (*i.e.*, meeting some but not all 3 criteria of an athlete) were excluded from the study.

Standard statistical methods have been used for descriptive statistics. Normally distributed continuous variables were analyzed by using an independent sample $t$ test and non-normally distributed with the use of the Mann-Whitney $U$ test. Categorical variables were analyzed by using the Pearson $\chi^2$ test. Binary logistic regression was also used to see differences in the prevalence of AIS between groups. The normality of different groups' data distribution was tested according to the "Kolmogorov-Smirnov" or the "Shapiro-Wilk" test. The hypothesis of equality of means was discarded when the probability (p) of a type I error was ≤5%. All statistical tests were 2-tailed. Analyses were performed with the use of the SPSS statistical software (version 12, Chicago-IL).

**Table 1. Distribution of Male and Female Athletes per Sport**

| Athletes* | Boys (n = 624) | Girls (n = 510) |
|---|---|---|
| Swimmers | 98 (15.7) | 63 (12.3) |
| Volleyball players | 39 (6.25) | 56 (10.98) |
| Water polo players | 31 (4.96) | 7 (1.37) |
| Handball players | 33 (5.28) | 23 (4.5) |
| Basketball players | 126 (20.1) | 74 (14.5) |
| Cyclists | 10 (1.6) | 18 (3.5) |
| Gymnasts (instrumental; rhythmic) | 72 (11.5) | 130 (25.4) |
| Tennis players | 14 (2.24) | 18 (3.52) |
| Soccer players | 172 (27.5) | 66 (12.9) |
| Runners | 11 (1.76) | 44 (8.62) |
| Rowers | — | 5 (0.9) |
| Boxers | 10 (1.6) | — |
| Table tennis players | 8 (1.28) | 6 (1.17) |

*The values are given as raw numbers with the percentages in parentheses.

## Results

A group of 2593 children (boys: 1276, girls: 1317), aged between 12 and 15 years, were initially enrolled in this study. This number corresponds to 94% of children attending all 5 schools. One hundred sixty-four children who did not meet all 3 criteria "of being an athlete," but were still practicing sports, were excluded from the study. Another 42 children suffering from endocrine disorders, or known skeletal deformities were also excluded. A final total number of 2387 children (boys: 1177, girls: 1210) were evaluated. The athletes group was consisted of 1134 (boys: 624, girls: 510) and the non-athletes of 1253 children (boys: 553, girls: 700). Soccer was the most popular sport among male athletes; gymnastics among female athletes (Table 1). There were no substantive differences between the study groups (Table 2), even though there was a trend toward significance, as far as weight ($P$ = 0.095) and onset of menarche ($P$ = 0.097) (between female athletes and nonathletes) were concerned. Male athletes followed a training schedule of an average of 11.91 h/wk; female athletes of 12.87 h/wk. Male athletes had been professionally practicing sports for an average of 3.57 years; female athletes for 3.73 years.

The physical examination revealed 177 "suspicious" children/cases of scoliosis; 96 athletes (boys: 39, girls: 57) and 81 nonathletes (boys: 27, girls: 54). Ninety-nine (athletes: 48, nonathletes: 51) true cases of AIS at a Cobb angle threshold of 10° were radiographically confirmed (Table 3). Three athletes (male: 2, female: 1) suffering from (radiographically confirmed) scoliosis coexisting with spondylolisthesis and 1 male nonathlete suffering from Scheuermann kyphosis combined with scoliosis

**Table 2. Clinical Data of Athletes and Nonathletes Adolescents**

| | Athletes | Nonathletes | P |
|---|---|---|---|
| Age* (yr) | | | |
| Male | 13.42 (0.89) | 13.41 (0.84) | 0.852‡ |
| Female | 13.44 (0.87) | 13.45 (0.83) | 0.762‡ |
| Weight* (kg) | | | |
| Male | 58.14 (11.07) | 58.59 (9.1) | 0.382‡ |
| Female | 58.32 (10.65) | 59.38 (10.05) | 0.094‡ |
| Height* (cm) | | | |
| Male | 160.27 (11.86) | 161.31 (10.93) | 0.142‡ |
| Female | 159.39 (10.41) | 159.22 (10.37) | 0.582‡ |
| BMI* (kg/m$^2$) | | | |
| Male | 23.03 (4.67) | 22.82 (4.79) | 0.671‡ |
| Female | 22.2 (3.7) | 22.7 (3.5) | 0.096‡ |
| Side of handedness† | | | |
| Male | | | |
| Right | 546 (87.5) | 490 (88.6) | 0.621§ |
| Left | 78 (12.5) | 63 (11.4) | |
| Female | | | |
| Right | 460 (90.1) | 623 (89) | 0.565§ |
| Left | 50 (9.9) | 77 (11) | |
| Onset of menstruation† (female) | | | |
| Yes | 343 (67.2) | 503 (71.8) | 0.097§ |
| No | 167 (32.7) | 197 (28.2) | |
| Positive familial† history of scoliosis¶ | | | |
| Male | 60 (9.6) | 42 (7.6) | 0.260§ |
| Female | 55 (10.7) | 91 (13) | 0.281§ |

*The values are given as the mean with the standard deviation in parentheses.
†The values are given as raw numbers with the percentages in parentheses.
‡Tests performed using Mann-Whitney *U* test.
§Tests performed using $\chi^2$ test.
¶At least 1 relative suffering from AIS.
BMI indicates body mass index.

were excluded from further analysis. The prevalence of AIS (Cobb ≥10°) and the degrees of the main scoliotic curve were not statistically significant different between athletes/nonathletes in general, male athletes/nonathletes, and female athletes/nonathletes (Tables 3, 4).

With the threshold reset at 20°, the prevalence of AIS was not statistically significant different between athletes/nonathletes ($P = 0.651$), male athletes/nonathletes ($P = 0.755$), and female athletes/nonathletes ($P = 0.615$) (Table 3). No statistically significant difference was found either between male athletes/nonathletes ($P = 0.221$), female athletes/nonathletes ($P = 0.694$), and athletes/nonathletes in general ($P = 0.9$) as far as the degrees of the main scoliotic curve were considered.

The logistic regression analysis also showed that none of the 4 categorical variables (athletic identity, sex, side of handedness, and history of scoliosis) made a significant prediction for the appearance of AIS (Table 5).

## ■ Discussion

The etiology of AIS remains, more or less, unknown.[1–7] Its exact relation (if any) to exercising is rather unclear. The latter has been considered both as a therapeutic means[13] and a causative factor of the former.[9] However, it is not at all certain that AIS and exercising may be related in a "cause and effect" type of model. All relative reports in the literature have been descriptive analyses of sport specific cohorts. They lacked comparison groups, blinded methodology, or statistical analysis.[5,6,8,9]

The prevalence of AIS has been reported to rise rather high among leading athletes. Becker[8] examined 366 swimmers (women: 193, men: 173) and reported a total prevalence of structural scoliosis of 6.9% in each team. Warren *et al*[5] reported 18 of a group of 75 professional female dancers to suffer from AIS. This extremely high prevalence of scoliosis (24%) was attributed to the relatively delayed onset of menstruation and to the high percentage of a positive family history in athletes with AIS when compared with the healthy ones. Hellström *et al*[6] radiographically evaluated the thoracolumbar spine of 143 male and female athletes and 30 nonathlete males who formed a control group. With the Cobb angle threshold set at 10°, the authors reported a 2–3 fold increase in the prevalence of AIS among athletes when compared with nonathletes. The reported number of gymnasts suffering from AIS was also significantly higher

**Table 3. Comparison of the Prevalence of Scoliosis Among Athletes and Non-Athletes Adolescents, at a Cobb Angle Threshold of 10° and 20°**

| | Structural Scoliosis* | | Prevalence of Scoliosis (%) | | OR | | 95% CI | | P† | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10° | 20° | 10° | 20° | 10° | 20° | 10° | 20° | 10° | 20° |
| Male | | | | | | | | | | |
| Nonathletes (n = 553) | 16 | 2 | 2.89 | 0.36 | 0.9 | 0.751 | 0.462–1754 | 0.125–4.513 | 0.757 | 0.755 |
| Athletes (n = 624) | 20 | 3 | 3.2 | 0.48 | | | | | | |
| Female | | | | | | | | | | |
| Nonathletes (n = 700) | 35 | 5 | 5 | 0.71 | 0.906 | 0.727 | 0.544–1.510 | 0.209–2.523 | 0.705 | 0.615 |
| Athletes (n = 510) | 28 | 5 | 5.49 | 0.98 | | | | | | |
| All children | | | | | | | | | | |
| Nonathletes (n = 1253) | 51 | 7 | 4.07 | 0.55 | 0.96 | 0.791 | 0.642–1.436 | 0.286–2.188 | 0.842 | 0.651 |
| Athletes (n = 1134) | 48 | 8 | 4.23 | 0.7 | | | | | | |

*The values are given as raw numbers.
†Tests performed using binary logistic regression.
OR indicates odds ratio; CI, confidence intervals.

**Table 4. The Characteristics of the Main Scoliotic Curve of Adolescents at a Cobb Angle Threshold of 10°**

| Gender | Category | Total Cases of Structural Scoliosis* | Thoracic Scoliosis† | Thoraco-lumbar Scoliosis† | Lumbar Scoliosis† | Degrees of main scoliotic curve‡ | P§ |
|---|---|---|---|---|---|---|---|
| Male | Athletes | 20 | 9 (8/1) | 5 (5/0) | 6 (1/5) | 16.85 ± 2.27 | 0.45 |
| | Non-athletes | 16 | 8 (8/0) | 3 (3/0) | 5 (0/5) | 17.4 ± 2.3 | |
| Female | Athletes | 28 | 14 (13/1) | 8 (7/1) | 6 (2/4) | 17.29 ± 3.18 | 0.707 |
| | Non-athletes | 35 | 21 (20/1) | 9 (8/1) | 5 (1/4) | 17.0 ± 2.8 | |

*The values are given as raw numbers.
†The values are given as raw numbers with the ratio of right to left curves in parentheses.
‡The values are given as the mean and the standard deviation.
§Tests performed using Independent sample *t* test.

than that of soccer players. However, patients did not undergo physical examination, authors do not mention whether vertebral rotation existed, and the relatively small control group did not allow a true comparison. Tanchev *et al*[9] estimated the prevalence of scoliosis among 100 female rhythmic gymnasts to be 12% and compared it with that (1.1%) of a school screening program conducted by them as well. This 10-fold increase of the incidence of AIS is certainly noteworthy. However, the groups were comparable only as far as the age of the participants was concerned and the authors knew in advance whether their patients were athletes or not. McMaster *et al*[14] assessed the physical activities of 79 patients with progressive AIS from their first year of life to their early teens and compared these with those of a control group of 77 patients. The authors discovered that progressive AIS is positively associated with an early introduction to swimming and ability to touch toe and negatively associated with participation in dance, skating, gymnastics/karate, and horse riding classes, concluding that the increased physical activities may possibly protect against AIS by involving neuromuscular feedback mechanisms common to all joints.[15]

Our study aimed to assess the potential relation (if any) between AIS and exercising in general, by comparing 1 group of athletes practicing several sports to 1 of nonathletes. No statistically significant differences were found between them as far as age, height, weight, body mass index, onset of menstruation, site of handedness, and positive familial history of AIS were concerned. The number of patients enrolled in each group reached the precalculated target necessary to reach secure conclusions. The age range of the participants (12–15 years) was selected because during this period of skeletal development AIS claims its higher frequency and final morphology.[12] All children were examined by 3 different orthopedic surgeons in a blinded and unbiased manner as far as their status of athletic activities was concerned. No statistically significant differences were found in the AIS prevalence between athletes and nonathletes with the Cobb angle threshold set at 10° and at 20° (Table 3).

**Table 5. Logistic Regression Predicting the Existence of Scoliosis (at a Cobb Angle Threshold of 10°) From Athletic Identity, Sex, Side of Handedness and History of Scoliosis**

| Predictor | B | Wald | P | OR |
|---|---|---|---|---|
| Athletic identity | 0.220 | 0.679 | 0.410 | 1.246 |
| Sex | −0.378 | 1.917 | 0.166 | 0.685 |
| Side of handedness | −0.011 | 0.000 | 1.000 | 0.989 |
| Family history of scoliosis | −20.777 | 0.001 | 0.982 | 0.000 |

Participation in athletic activities was one of the examined parameters in a statistical model that tried to reveal any significant factor predicting the appearance of AIS. The results showed that exercising does not increase the likelihood of children suffering from AIS (Table 5). It is true that the percentage of adolescents diagnosed with AIS (Cobb angle ≥10°) in this study is rather high (4.14%), especially when taking into consideration the fact that as much as 5.49% of female athletes and 5% of nonathletes were diagnosed with AIS. However, this was more or less expected, as the prevalence of AIS among adolescent inhabitants of the geographical region that this study was performed, has been found to be well above the average national (mean value of 2.9%, range 1.1%–5.7%) and among the highest in our country.[10,11] Furthermore, the boy/girl ratio in the present study (1/1.75)–intermediate to those reported in studies (1/2.1[10] and 1/1.35[16]) performed at different parts of our country–substantially contributed to the relatively increased prevalence of AIS among girls. It must be noted here that even though female sex does not seem to be a statistically significant predictive factor for the appearance of AIS, the risk of girls developing AIS is almost double when compared with the boys (Wald criterion = 1.91), with the *P* value (*P* = 0.166) showing a slight tendency toward significance, although it is not statistically significant (Table 5). As this finding might have actually been related to the initially used threshold of 10°, we performed a further statistical analysis that included only patients suffering from AIS with a Cobb angle ≥20° that also failed to show any significant differences. The 2 groups were also comparable as far as the degrees of the main scoliotic curve were concerned with the Cobb angle threshold set at 10° and at 20° (Tables 3, 4).

Warren *et al*[5] reported that children suffering from AIS are taller when compared with healthy children of the same age. The authors believe that taller persons may be "at risk" for scoliosis because of prolonged growth spurts and other important environmental factors.

Machida[1] on the contrary, in a review article, disagrees with this statement. Our results (after the height of patients suffering from AIS had been corrected according to the Kono *et al*[17] method) showed no statistically significant differences concerning the height of boys suffering from AIS or not ($P = 0.137$) and girls suffering from AIS or not ($P = 0.325$).

Tanchev *et al*[9] support that one of the causes of the increased prevalence of AIS among young female rhythmic gymnastics athletes is their very low weight. Our results showed no statistically significant difference of the weight of boys suffering from AIS or not ($P = 0.136$) and girls suffering from AIS or not ($P = 0.55$).

Another potentially causative factor of AIS is the asymmetric overloading of the spine. Tanchev *et al*[9] reported that 99% of their patient-athletes were right-handed (a very high percentage when compared with general population). Our results showed no statistically significant increased risk for the development of AIS in relation with the handedness side in boys ($P = 0.379$) and girls ($P = 0.496$). Further analysis showed that the side of handedness does not seem to be a single predictive factor for the development of AIS (Table 5).

It is highly possible that a genetic factor may play a potentially pathogenetic role in the development of AIS, as the prevalence of the latter is much higher among relatives.[18,19] However, this was not verified by our results (boys: $P = 0.5$, girls: $P = 0.250$) as a positive familial history of AIS does not seem to be a statistically significant single factor contributing to the development of AIS (Table 5).

The relatively low levels of estrogens in young female athletes are often associated with amenorrhea and delayed onset of menstruation. The latter, regardless of its cause[20], is associated with an increased incidence of AIS.[21] No statistically significant difference was found between the number of girls diagnosed or not with AIS, among the subpopulation of girls that did not report onset of menstruation ($P = 0.56$). No statistically significant difference was found between the total number of athlete (32.8%) and nonathlete (28%) girls who did not report onset of menstruation either ($P = 0.097$). This could be explained by the fact that this was a cross-sectional study, examining only the existence or not of menarche and not the actual age that menarche occurred. Furthermore, the average reported age of menarche in our country (12.5–12.8 years)[22,23] is well below the average age of the girls participating in this study (13.4 years).

This study however, has certain limitations. An important one is the way an athlete "is determined." As literature failed to provide sufficient rules, it was decided that only children simultaneously fulfilling 3 different criteria could be characterized as athletes. This definition of an athlete is questioned; however, since our groups of athletes and nonathletes were comparable as far as their weight, height, and body mass index were concerned. This paradox could be attributed to several reasons; one of them being the fact that not only elite athletes of one (or few) sport(s) who usually pay great attention to the quality and quantity of their food, formed the athletes' group. Furthermore, most of the sports practiced by the athletes of this study do not necessarily require low body weight. Last, but not least, is the fact that the athletes' body weight may well be the end result of their increased muscles' mass and not their body's fat. (Tables 1, 2). Another limitation is that athletes practiced a lot of different sports activities, hence their group lacked homogeneity. However, this is not necessarily a disadvantage, as this study aimed to discover a possible association between exercising (in general) and AIS. Furthermore, the prevalence of AIS among adolescents practicing several sports (*e.g.*, soccer, basketball, volleyball, and track) is evaluated for the first time.

Determining the threshold of the Cobb angle was not exactly a limitation, but certainly an issue. Using a threshold of 10° would probably "produce" a larger series of patients diagnosed with AIS, thus allowing us to reach more secure statistical conclusions. On the other hand, a threshold of 20° would possibly lead to both different (less biased?) results and a smaller sample. Being unable to decide which threshold was the best, we decided to use both. It is our belief though that the small number of patients suffering from AIS with a curve ≥20° (0.62%) cannot adequately support any final scientific conclusions, even though no statistically significant differences were found between the groups of athletes and nonathletes at either Cobb-angle thresholds.

It is extremely difficult to perform such a study without making certain compromises. Examining a large series of patients (especially with the Cobb angle threshold set at 20°) is certainly mandatory; rendering the use of a full-scale radiographic examination of all patients impossible. On the other hand, the Adam's forward bending test, criticized by many and endorsed by others,[10,16,24] is a fast and adequately reliable method of detecting suspicious cases of AIS, especially when used in mass-screening studies. However, the coexistence of AIS with other skeletal deformities (*e.g.*, spondylolysis-spondylolisthesis, Scheuermann kyphosis)[25] may well interfere with the detection of suspicious cases and their further evaluation. Things seem more complicated, because the prevalence of certain skeletal deformities[7,26] is higher among athletes participating in sports involving repetitive hyperextension maneuvers, and other disorders or conditions[1,5,27] as well may play a potential role. Having all that in mind, and additionally the fact that our study is a cross-sectional one (thus allowing reporting correlations only), we tried to perform an unbiased study with the application of strict inclusion and exclusion criteria. It is our belief though, that more observations (probably similar epidemiological studies that will include very large samples of subjects at successively higher thresholds of Cobb angle) are needed to clearly and without any doubt define whether AIS and exercising are in any way connected.

## Key Points

- The potential relation between adolescent idiopathic scoliosis (AIS) and exercising remains uncertain.
- This cross-sectional observational study evaluated the prevalence of AIS among 2 groups of adolescents (1 of athletes and 1 of nonathletes) to determine whether athletic activities are associated with the development of AIS or not.
- No statistically significant differences were found between the 2 study groups as far as the age, the weight, the height, the family history of scoliosis, the side of handedness, and the onset of menstruation of the patients were concerned.
- No statistically significant differences were found between the 2 study groups concerning the prevalence of AIS (at a Cobb angle threshold of 10° and of 20°) and the degree of the main scoliotic curve.
- Systematic exercising is probably associated neither with the development of AIS nor with the degree of the main scoliotic curve.

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