ORIGINAL ARTICLE

Prevalence and Predictors of Adolescent Idiopathic Scoliosis in Adolescent Ballet Dancers

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Abstract

Objective: To determine any differences between the prevalence of adolescent idiopathic scoliosis in ballet dancers who are girls compared with age-matched nondancers, and to establish if any relations exist between the presence of scoliosis and generalized joint hypermobility, age of menarche, body mass index (BMI), and the number of hours of dance training per week.

Design: Cross-sectional, matched pair study.

Setting: Dance school.

Participants: Dancers (n=30) between the ages of 9 and 16 years were recruited from a certified dance school in Western Australia; each dancer provided a consenting age-matched nondancer (n=30).

Interventions: Not applicable.

Main Outcome Measures: Measurements were taken for angle of trunk rotation using a scoliometer (presence of scoliosis) and for height and weight to produce generalized joint hypermobility using Beighton criteria and an age-adjusted BMI, respectively. A subjective questionnaire regarding age of menarche and participation in dance and other sports was completed.

Results: Thirty percent of dancers tested positive for scoliosis compared with 3% of nondancers. Odds ratio calculations suggest that dancers were 12.4 times more likely to have scoliosis than nondancers of the same age. There was a higher rate of hypermobility in the dancer group (70%) compared with the nondancers (3%); however, there were no statistically significant relations between scoliosis and hypermobility, age of menarche, BMI, or hours of dance per week.

Conclusions: Adolescent dancers, similar to adult dancers, are at significantly higher risk of developing scoliosis than nondancers of the same age. Vigilant screening and improved education of dance teachers and parents of dance students may be beneficial in earlier detection and, consequently, reducing the risk of requiring surgical intervention.

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Adolescent idiopathic scoliosis (AIS) is a 3-dimensional, structural curvature of the spine, with lateral and rotational components, arising at pubescence without definitive cause.[1] Worldwide, the reported prevalence of AIS varies from .47% to 5.2%, with 1 study stating a prevalence as high as 9.2%.[2,3] The prevalence of AIS in Australia is reported between 1.5% and 10% and represents 90% of all scoliosis.[4,5] It is significantly more common in women, especially in curves exceeding 30°.[5] Clinical indicators for AIS (eg, lateral curvature, rib hump, hip and shoulder asymmetries) typically appear early in adolescence and can lead to physical deformity and pain, reduced self-esteem, higher depression rates, and pulmonary compromise.[2,6-8]

Treatment of AIS varies depending on the degree of curvature, patient characteristics, and feasibility, with current methods, including monitoring and spinal bracing, and for progressive or unstable curves or curves expected to exceed 50° by skeletal maturity, surgery.[1,2] Evidence suggests that earlier detection is associated with a decreased rate of surgical treatment and fewer complications, including deformity, pain, pulmonary compromise, and reduced degree and complication of the curvature.[1,8]

Several studies report higher prevalence of AIS in adult classical ballet dancers who are women than the general population, finding scoliosis in 24% to 50% of adult participants.[9-11] Similar findings have been found in sports sharing similar characteristics to dance, including rhythmic gymnastics, where the incidence of scoliosis was reported to be 10 times that of a nongymnast group.[9,10] Several theories as to why such a high prevalence of

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scoliosis exists in dancers, with a range of sources suggesting that the tall, ectomorphic body composition, hypermobility, delayed maturation, and dietary abnormalities characteristic of dancers may be related.[11]

AIS is of unknown etiology; however, significant evidence suggests its development is multifactorial and may be associated with the many identified physical characteristics. Many genetic links have been demonstrated in the literature and appear to play a role; however, no single genetic locus has been identified; hence, a polygenetic influence is possible.[12-14] Research has also found links between AIS and generalized joint hypermobility and flexibility, delayed menarche, and low body mass index (BMI).[15] These characteristics are common (and desired) in dancers and have been associated with an increased incidence of scoliosis in professional dancers.[16]

Although several authors have noted markedly higher rates of AIS in adult professional dancers who are women compared with normative population values, evidence as to whether high rates exist in adolescent dancers is lacking.[17] Because patient outcomes improve with earlier detection and treatment, investigation to determine if there is a difference in the prevalence of AIS in adolescent dancers compared with age-matched nondancers could lead to earlier detection of scoliosis in dancers and improved health and career outcomes. Furthermore, investigation into whether physical characteristics found to be associated with scoliosis in previous literature (joint hypermobility, delayed menarche, low BMI) are related to the presence of scoliosis in the adolescent dancers being studied could help identify which characteristics may identify young dancers at risk of developing AIS.

The primary purpose of this study was to determine if there was a difference between the prevalence of AIS in adolescent, ballet dancers who are girls compared with age-matched nondancers. The secondary purpose of the study was to establish whether there is a relation between the presence of scoliosis and individual physical characteristics, namely generalized joint hypermobility, age of menarche, BMI, and the number of hours of dance classes and practice per week.

Methods

Study design

A cross-sectional study was used to compare the prevalence of scoliosis between a group of 30 adolescent dance students who are girls and 30 nondancers who are girls of comparative age and investigate the relation between scoliosis and the previously identified physical factors.

Participants

The study involved 60 healthy adolescents who are girls and between the ages of 9 and 16 years (mean, 12y). Thirty of these participants were adolescent dancers recruited via flyer advertising from certified dance schools in the southwest of Western Australia. In order to meet inclusion criteria for the study, the

List of abbreviations:

  AIS   adolescent idiopathic scoliosis
  ATR   angle of trunk rotation
  BMI   body mass index

dancers needed a minimum of 3 years dance experience and participation in at least 4 hours of structured dance training per week under the tuition of a qualified dance teacher. Each recruited dancer was required to provide a consenting nondancer who had no involvement in dance, gymnastics, or calisthenics and was of the same age. All participants and a legal guardian signed an informed consent form prior to participation. This study was approved by the Curtin University Human Research Ethics Committee (PT218/2012).

Sample size

A priori calculations for the sample size of 60 were based on detecting a 30-point difference in the rate of scoliosis between the 2 groups that would mirror the difference in mean prevalence of scoliosis in adult ballet dancers and that in the general population with a power of 80% and alpha level of .05.

Outcome measures

Indication of scoliosis

To determine the presence of scoliosis, the angle of trunk rotation (ATR) was measured using an Orthopaedic Systems Baseline Scoliometer 5280[a] originally developed by Bunnell[18] and following the protocol described by Amendt[19] (fig 1). This specialized inclinometer is used to screen for the presence of scoliosis through detection of the vertebral and costal rotation integral to scoliosis, given it is defined as a 3-dimensional disorder.[1,18] An 8-year prospective study of 1065 patients concluded that the scoliometer has 87% sensitivity in detecting lateral curves exceeding 10° and 100% sensitivity in predicting spinal curvatures with Cobb angles exceeding 20° with an ATR of 5°, roughly indicating a curvature of >20°.[16,17] The scoliometer also has high interrater and intrarater reliability (.86−.97) and excellent reliability and sensitivity in detecting scoliosis, particularly where a double curve is present.[17] It is also nonionizing and relatively inexpensive and simple to use.[20] However, although the scoliometer's ability to detect the presence of curvature is excellent, the correlation to Cobb angle size, while statistically significant, is relatively weak; therefore, although the scoliometer is sufficient to
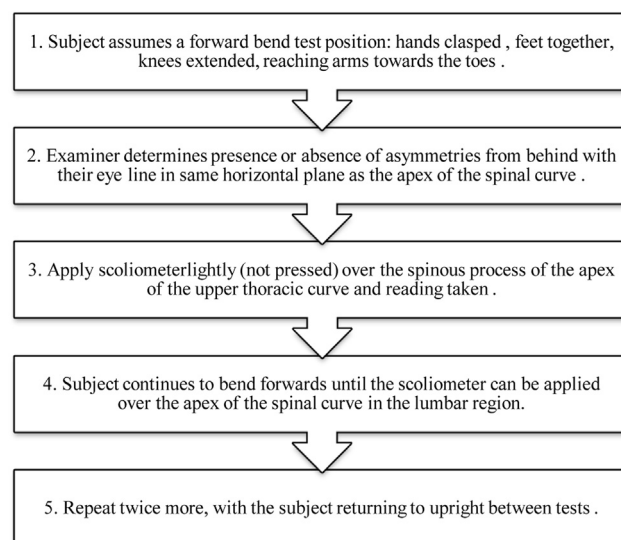

1. Subject assumes a forward bend test position: hands clasped , feet together, knees extended, reaching arms towards the toes .

2. Examiner determines presence or absence of asymmetries from behind with their eye line in same horizontal plane as the apex of the spinal curve .

3. Apply scoliometerlightly (not pressed) over the spinous process of the apex of the upper thoracic curve and reading taken .

4. Subject continues to bend forwards until the scoliometer can be applied over the apex of the spinal curve in the lumbar region.

5. Repeat twice more, with the subject returning to upright between tests .

Fig 1 Method of measurement of the ATR using a scoliometer.