# The influence of social determinants on deformity magnitude at initial presentation in adolescent idiopathic scoliosis

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INTRODUCTION: Adolescent Idiopathic Scoliosis (AIS) is the most common spinal deformity observed in pediatric patients. Treatment strategies for AIS are determined by the relationship between deformity magnitude and progression risk given skeletal maturity status. Diagnostic delays often manifest as more severe deformities, which are less responsive to non-invasive treatments such as bracing. Thereby increasing the necessity for operative management. Social determinants have been found to affect the timing of diagnosis, access to care, and adherence to treatment recommendations in orthopaedic surgery. However, there are inconsistences in literatures pertaining to the influence of sociodemographic variables on deformity at initial presentation. In addition, current literature in this area is disproportionately concentrated within academic centers located in large metropolitan regions. This study aims to augment current literature on the impact of social health determinants on the severity of AIS deformity at the initial presentation.

METHODS: We conducted a single-center, retrospective cohort study at a tertiary hospital. Subjects were required to be between the ages of 10 - 18 at their initial presentation for AIS from 2018 to 2023. Full-length standing spinal radiographs of sufficient quality for AIS evaluation were required for inclusion. Deformity magnitude was calculated by measuring the largest cobb angle among the proximal thoracic, main thoracic, and thoracolumbar/lumbar region, respectively. Patients were categorized based on Scoliosis Research Society (SRS) AIS management recommendations. Curves less than 10° were considered a physiologic variant and not categorized as scoliosis resulting in no additional follow-up. Those with curves between 10° to 25°degress, were observed with serial radiographs every 6 months. Curves from 25° to 44°, were recommended a minimum of 18 hours of bracing to slow curve progression. Surgical intervention was considered for curves greater than 45°. Social health determinant variables included annual household income, parental education level area deprivation index, insurance type, and distance traveled for initial evaluation. Data were analyzed utilizing either a One-Way Analysis of Variance for continuous variables or a Chi Square Test for categorical variables. A p-value of less than 0.05 was consisted significant.

RESULTS: A total of 342 patients met inclusion criteria. The severity of the primary deformity at initial presentation did not vary significantly by sex ($p=0.504$), household income ($p=0.278$), parental education level ($p=0.385$), state ADI ($p=0.297$), or national ADI ($p=0.126$). Conversely, a significant difference ($p<0.001$) was observed between distance traveled and initial deformity magnitude with patients who had the largest deformities (>45°) traveling almost double the distance (mean: 133.0±121.0 miles) of those with more moderate, non-operative deformities compared to those (mean: 61.2±61.4 miles for <10°; 60.2±74.2 miles for 10°–24°; and 63.3±55.6 miles for 25°–44°). In addition, there was a significant association between commercial insurance and the deformity magnitude ($p = 0.008$, 58.9% for 10° – 24°, 68.1% for 25° – 44° and 63.9% for ≥45°), compared to uninsured or Medicaid patients.

DISCUSSION AND CONCLUSION:

Our institution, located in the Midwest, serves a population of 128,555 with extension into a vast rural area, where we are the closest available tertiary pediatric specialty hospital. Our results revealed that social determinants, such as household income, parental education, and area deprivation index, did not significantly influence deformity magnitude at initial presentation at our institution. However, a significant association was seen with distance traveled for curves of >45°, and insurance status. Overall, this study contributes a unique perspective because current literature in this area is disproportionately concentrated within academic centers located in large metropolitan regions, thereby potentially neglecting unique healthcare conditions and sociodemographic factors prevalent within rural areas. The implications of our research highlight the need for additional studies that assess the barriers to early diagnosis and treatment of AIS, particularly in non-metropolitan areas.

**Table 1.** Summary Statistics By Binned Deformity Magnitude at Initial Presentation.

| Characteristic | Binned Deformity Measures | | | | Overall |
|---|---|---|---|---|---|
| | <10° (0) | 10° – 24° (1) | 25° – 44° (2) | ≥45° (3) | P-Value |
| **Sex** | | | | | = 0.504 |
| Males | 24; 35.3% | 48; 34.0% | 18; 25.0% | 21; 34.4% | |
| Females | 44; 64.7% | 93; 66.0% | 54; 75.0% | 40; 65.6% | |
| **Income** | | | | | = 0.945 |
| Less Than $25,000 (Low) | 10; 14.7% | 20; 14.2% | 12; 16.7% | 10; 16.4% | |
| $25,000 – $100,000 (Medium) | 41; 60.3% | 75; 53.2% | 38; 52.8% | 32; 52.5% | |
| More Than $100,000 (High) | 17; 25.0% | 46; 32.6% | 22; 30.6% | 19; 31.1% | |
| **Insurance Status** | | | | | = 0.008 |
| None (0) | 19; 27.9% | 32; 22.7% | 5; 6.9% | 7; 11.4% | |
| Commercial (1) | 30; 44.1% | 83; 58.9% | 49; 68.1% | 39; 63.9% | |
| Medicaid (2) | 19; 27.9% | 26; 18.4% | 18; 25.0% | 15; 24.6% | |
| **Parental Education** | | | | | = 0.452 |
| N / A | 16; 23.5% | 33; 23.4% | 9; 12.5% | 8; 13.1% | |
| Less Than High School | 5; 7.4% | 5; 3.5% | 4; 5.6% | 5; 8.2% | |
| High School / GED | 13; 19.1% | 23; 16.3% | 22; 30.1% | 13; 21.3% | |
| College (4 Year) | 16; 23.5% | 37; 26.2% | 23; 31.9% | 18; 29.5% | |
| Postgraduate (MS, PhD, etc.) | 18; 26.5% | 43; 30.5% | 14; 19.4% | 17; 27.9% | |
| | | | | | |
| **Chronological Age (yrs.)** | 13.6±2.1 (10.0 – 17.2) | 14.1±1.9 (10.1 – 18.7) | 14.0±1.9 (10.2 – 17.4) | 14.2±1.8 (10.4 – 19.3) | = 0.369 |
| **State ADI** | 5.2±2.9 (1.0 – 10.0) | 4.8±2.6 (1.0 – 10.0) | 5.1±2.6 (1.0 – 10.0) | 4.3±2.7 (1.0 – 10.0) | = 0.296 |
| **National ADI** | 65.4±21.0 (17.0 – 98.0) | 63.4±19.2 (21.0 – 98.0) | 65.7±18.0 (27.0 – 98.0) | 58.2±20.7 (20.0 – 96.0) | = 0.126 |
| **Distance Traveled (miles)** | 61.2±61.4 (1.1 – 432.0) | 60.2±74.2 (0.5 – 636.0) | 63.3±55.6 (3.8 – 238.0) | 133.0±121.0 (2.8 – 607.0) | < 0.001 |
| | | | | | |

**Table 1.** Summary Statistics Split by Binned Deformity Magnitude at Initial Presentation and Social Determinants. Categorial data are represented as total sample size (n) and percentage (%) of the total sample whereas continuous variables are represented by the mean ± standard deviation and range; categorical variables were compared using a Chi-Square Test and continuous variables were compared using a One-Way Analysis of Variance. Abbreviation: ADI = Area Deprivation Index