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Beyond the curve: The impact of trunk and shoulder symmetry on self-image and mental health in adolescent idiopathic scoliosis

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ABSTRACT

Background: Adolescent idiopathic scoliosis (AIS) influences not only physical health but also self-image and mental wellbeing. The impact of clinical trunk and shoulder symmetry on these psychosocial domains remains under-investigated.
Objectives: To analyse correlations between trunk/shoulder asymmetry and domains of self-image and mental health, and to identify key deformity parameters affecting patient perception in AIS.
Methods: Cross-sectional study of 100 AIS patients attending Government Medical College Thiruvananthapuram, utilizing SRS-22r, POTSI, SAQ, and surface symmetry metrics. Correlation analyses conducted using Pearson's correlation coefficient "r".
Results: Moderate negative correlation exists between trunk asymmetry (POTSI) and self-image ($r = -0.43$, $p < 0.01$), mild associations for shoulder parameters. No significant correlation exists between POTSI and mental health. Self-image and mental health domains moderately interrelated ($r = 0.48$, $p < 0.01$).
Conclusion: Surface trunk and shoulder asymmetry negatively impacts self-image, underscoring the need for appearance-focused assessment and multidisciplinary management.

1. Introduction

Adolescent idiopathic scoliosis (AIS) is known to affect multiple domains of patient well-being beyond physical health, especially in terms of self-image and mental health. While previous studies[1,2,3] have evaluated clinical and radiological parameters, the nuanced relationship between observable asymmetries (such as trunk and shoulder imbalance) and the psychological perception of self remains inadequately explored. Most current literature focuses on overall curve magnitude (Cobb's angle), ignoring measurable surface characteristics[4,5] like the Trunk Asymmetry Index, POTSI, or angular differences, which may have a more direct influence on patient self-perception and mental wellness. Furthermore, there is limited data connecting detailed clinical parameters (such as trapezial angle[6] or clavicle angle[6]) to scores on validated self-image and mental health assessment tools.

1.1. Knowledge gap

Despite the recognition of the psychosocial burden of AIS[7,8] there is a lack of published research that systematically correlates quantifiable trunk and shoulder asymmetry with validated measures of self-image and mental health. Most available studies either aggregate all physical aspects or rely on global assessment scales, failing to pinpoint which clinical markers most closely predict psychological distress or poor self-perception in affected adolescents. This gap limits the ability of clinicians to prioritize treatment targets or patient counselling based on surface examination or imaging findings.

1.2. Aims and objectives

1. To systematically analyse whether trunk and shoulder symmetry, as measured by standardized clinical parameters (POTSI,[9] clavicle angle, trapezial angle, trapezial area ratio), correlate with self-image and mental health scores in adolescents with idiopathic scoliosis.
2. To identify which clinical asymmetry parameters show the strongest association with negative perceptions of self-image and mental health in this group.

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3. To provide data that can guide clinicians towards interdisciplinary management, focusing not only on curve correction but also targeted interventions for improved psychosocial outcomes.

2. Materials and methods

This cross-sectional study included 100 adolescents (aged between 10 and 20 years) with thoracic idiopathic scoliosis who attended the outpatient department of Government Medical College, Thiruvananthapuram. The study protocol was approved by the Institutional Ethics Committee of Government Medical College, Thiruvananthapuram (Approval No. IEC/GMCT/2024/06/15). Patients with revision surgeries and neuromuscular disorders were excluded. Of these, 74 patients were kept under observation (waitlisted for surgery or braced) while 26 others underwent surgical correction. Written informed consent was obtained from all participants and guardians. All patients filled the SRS -22r, SAQ questionnaire and clinical photographs from the front and back of the patients were taken. Clinical photographs were obtained as per the standardised protocol[10] – posterior photographs were taken with patients minimally clothed to expose the trunk, following standardised privacy protocols. For frontal photographs patient were allowed to wear a brassier. Photographs were taken with subjects standing against a blank wall with arms by the sides and hair put up and were shot with mounted digital camera (Canon EOS R50) at 2 m distance centering interscapular area.

2.1. SRS-22r questionnaire[11]

The Scoliosis Research Society-22r (SRS-22r) is a validated self-assessment tool. The 'Self-Image' domain assesses body appearance and symmetry, while the 'Mental Health' domain evaluates anxiety and emotional distress related to scoliosis. Each item contains a 5-level Likert scale ranging from worst (1 point) to best (5 point); results are expressed as the mean score of each domain, and total score of the scale. Lower scores indicate poorer quality of life.

2.2. POTSI[9]

The Posterior Trunk Symmetry Index (POTSI) quantifies trunk asymmetry using anatomical landmarks such as C7, acromion, and scapular angles. Higher scores denote greater asymmetry. In the study we used SCODIAC app (Version.2.7) for measuring POTSI which can be downloaded from the internet for free. To decrease intraclass variation, measurement using app was done by a team consisting of three researchers.

2.3. SAQ (spinal appearance questionnaire)[12]

A pictorial tool evaluating perceived spinal deformity. Questions Q6, Q7, Q8, and Q13 directly assess shoulder symmetry and prominence.

2.4. Clinical measurements

Clavicle angle, trapezial angle, and trapezial area ratio were derived from standardized photographs using digital measurement tools to supplement POTSI and SAQ data. Fig. 1 shows the measurement of Clavicle angle, Trapezial Angle & Trapezial Area Ratio.

2.5. Statistical analysis

All analyses were performed using SPSS version 27 (IBM Corp., USA). Descriptive statistics (mean, SD) were computed. Pearson's correlation coefficient (r) assessed associations between clinical symmetry parameters and psychosocial domains. Interpretation of r: 0.00–0.19 = very weak, 0.20–0.39 = mild, 0.40–0.59 = moderate, 0.60–0.79 = good, ≥0.80 = very strong. Significance was set at $p < 0.05$. Inter-rater reliability for POTSI and angle measurements was tested on 10 randomly selected cases, showing ICC >0.85.

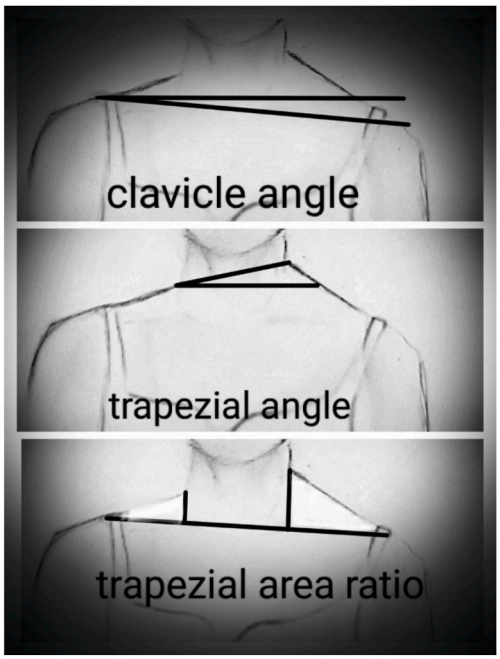

Fig. 1. Clavicle angle, Trapezial angle, Trapezial area ratio.

3. Results

Demographic details of the patient cohort are given in Table 1 and descriptive statistics in Table 2. Correlation and correlation matrix results are given in Tables 3 and 4.

The data indicates a significant negative correlation between self-image and the Posterior Trunk Symmetry Index (POTSI; $r = -0.431$, $p < 0.01$), suggesting that greater trunk asymmetry is associated with poorer self-perception. In contrast, mental health shows no meaningful correlation with POTSI ($r = -0.002$). Several scoliosis appearance items—Q6 (shoulder level), Q7 (shoulder blade rotation), Q8 (shoulder angle), and Q13 (perception of shoulder posture, e.g., desire for more even shoulders) — all negatively correlate with self-image ($r = -0.199$, -0.240, -0.361, and -0.447 respectively), indicating that as concerns about shoulder appearance increases – i.e., when shoulder posture worsens, self-image correspondingly declines. Mental health also negatively correlates with Q8 ($r = -0.203$, $p < 0.05$) and Q13 ($r = -0.224$, $p < 0.05$), suggesting that these appearance-related concerns adversely affects psychological well-being. Meanwhile, clinical parameters such as clavicle angle, trapezial angle, and trapezial area ratio shows no significant correlation with either self-image or mental health, implying that objective anatomical measurements may not strongly influence psychological outcomes.

Higher POTSI scores (indicating greater trunk asymmetry) were moderately associated with lower self-image scores ($r = -0.43$). Shoulder parameters showed mild to moderate correlations with self-

Table 1
Demography.

Demographics	Pre OP (N = 50) Mean ± SD/n (%)	Brace (N = 24) Mean ± SD/n (%)	Post OP (N = 26) Mean ± SD/n (%)
Age	15.54 ± 3.46	14.71 ± 2.69	16.77 ± 3.41
Gender			
Male	4 (8)	5 (20.8)	3 (11.5)
Female	46 (92)	19 (79.2)	23 (88.5)
Cobb's angle	51.02 ± 15.57	28.73 ± 10.68	26.01 ± 11.87

Table 2
Descriptive statistics.

Parameter	Mean	Standard Deviation
Self-Image (SRS-22r)	3.47	0.83
Mental Health (SRS-22r)	4.07	0.90
POTSI	31.64	20.88
Clavicle Angle	2.76	2.43
Trapezial Angle	5.22	3.76
Trapezial Area Ratio	1.11	0.39

Table 3
Correlation.

	Self-Image	Mental health
POTSI	−0.431[a]	−0.002
Clavicle angle	−0.185	−0.094
Trapezial Angle	−0.109	0.036
Trapezial Area Ratio	−0.176	−0.179
Q:6	−0.199[b]	−0.093
Q:7	−0.240[b]	−0.177
Q:8	−0.361[a]	−0.203[b]
Q:13	−0.447[a]	−0.224[b]

[a] Correlation is significant at the 0.01 level (2-tailed).
[b] Correlation is significant at the 0.05 level (2-tailed).

Table 4
Correlation matrix.

Parameter Pair	r value	Interpretation
POTSI vs. Self-Image	−0.43	Moderate negative
POTSI vs. Mental Health	−0.0017	No meaningful correlation
Self-Image vs. Mental Health	0.48	Moderate positive
Clavicle Angle vs. Self-Image	−0.18	Mild negative
Trapezial Angle vs. Self-Image	−0.11	Mild negative
Trapezial Area Ratio vs. Self-Image	−0.18	Mild negative
Q13 (SAQ Shoulder Symmetry) vs. Self-Image	−0.45	Moderate negative

image, but minimal with mental health domains. Self-image and mental health were moderately correlated (r = 0.48), showing their psychological interdependence.

4. Discussion

The present study evaluated how trunk and shoulder symmetry quantified by clinical metrics such as POTSI, clavicle and trapezial angles, and SAQ scores influence self-image and mental health in adolescents with idiopathic scoliosis. The findings revealed a moderate negative correlation between trunk asymmetry (POTSI) and self-image, with mild-to-moderate association for shoulder parameters, but poor correlation with mental health domains.

4.1. Findings in previous literature

Multiple studies have addressed the relationship between trunk aesthetics and patient-reported outcomes in AIS. Fortin et al.[13] reported that trunk imbalance caused posture asymmetries and affected self-image and appearance quality of life in AIS. They[14] suggested that assessment of trunk imbalance requires integrating radiographic measures with clinical and 3D surface evaluations to capture both internal deformity and external appearance. Catanzariti et al.[15] found that patients with major AIS displayed misperception of their trunk appearance, indicating altered body image representation. Belli et al.,[16] using body image questionnaires (SRS-22, TAPS), confirmed the negative impact of AIS on adolescents' self-perceived body image and stressed the need for early attention in management. Thielsch et al.[17] demonstrated that pictorial measures such as SAQ and TAPS correlated more strongly with self-image and stress than verbal questionnaires, supporting the importance of visual-surface deformity in patient perception. Conversely, Cheshire et al.[18] found that SRS-22r domains of self-image and mental health correlated poorly with objective deformity parameters, raising concern about the instrument's sensitivity to surface symmetry. Bago et al.[19] also noted good correlation between perceived trunk deformity scales and curve magnitude, particularly for the WRVAS[12] and TAPS.

4.2. Novelty and addressed knowledge gap

Unlike previous studies that either aggregated deformity indices or relied principally on Cobb angle/radiologic severity, this study uniquely correlated comprehensive surface symmetry parameters—including POTSI and detailed shoulder metrics (clavicle/trapezial angles and SAQ items)—with validated self-image and mental health domains. It interrogates the specificity and clinical relevance of trunk and shoulder symmetry in psychosocial assessment, highlighting patient-centred deformity aspects over classical radiologic classification.

4.3. Limitations

Several limitations must be acknowledged. The cross-sectional design precludes causal inference, and recruitment from a single centre limits generalizability. Subjective response bias in self-reported scales (SRS-22r, SAQ) is possible, and the study did not evaluate longitudinal changes or the impact of interventions. Sample consisted predominantly of moderate thoracic curves, and factors such as pain and social support were not independently analysed. Instrument limitations of SRS-22r, including poor sensitivity for surface deformity, may underestimate true associations.

4.4. Scope for future research

Prospective, multicentre studies should be conducted to validate these findings. Incorporating advanced surface topography and 3D imaging[4] could enhance objective deformity assessment. Longitudinal studies tracking surgical and nonsurgical interventions and their effect on psychosocial outcomes are needed. Malhotra et al.[20] has questioned the SRS 22r questionnaires ability to discriminate between mild and moderate scoliosis. Further analysis of the relative impact of trunk versus shoulder/cervical symmetry across severity spectra and cultural contexts is warranted. Developing and validating more sensitive PROMs to capture surface deformity's effect on adolescent self-image would refine both research and clinical assessment. Routine inclusion of surface symmetry measures such as POTSI and SAQ could help identify adolescents at risk of low self-image even when radiologic correction appears satisfactory.

5. Conclusion

This study demonstrates a moderate negative correlation between clinical trunk asymmetry and self-image in adolescents with thoracic idiopathic scoliosis, with supplementary but weaker associations for shoulder symmetry markers. Surface deformity significantly affects self-perception, emphasizing the need for integrated psychosocial consideration in assessment and management. The above research supports moving "beyond the curve" to include patient-centred, appearance-based parameters in outcome evaluation. Visual symmetry should be given due consideration in deciding on management protocols for Adolescent idiopathic scoliosis.

Guardian/patient consent

Only consented/assented patients were included in the study. They

were explained the nature of the study, freedom to withdraw at any point in the study and consent forms were filled and signed by the participants and parents.

Ethical statement

IRB approval was obtained from the Human Ethics Committee, Government Medical College, Thiruvananthapuram, Kerala, India. The approval number is 06/15/2024/MCT.

Credit author statement

Dr. A. Shiju Majeed: Conceptualization, Investigation, Methodology, Roles/Writing – original draft, Writing – review & editing.

Dr. B.P. Vinodkumar: Supervision, Writing – review & editing.

N. Ajina: Project administration, Data curation, Validation.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jorep.2026.100897.

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