



Review Article

Health-Related Quality of Life Among Adolescent Girls with Idiopathic Scoliosis Using Spinal Orthoses: A Systematic Review

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ABSTRACT

Background: Adolescent idiopathic scoliosis (AIS) affects 2–4% of adolescents and is predominantly diagnosed in girls during pubertal growth. Bracing is the primary conservative intervention to prevent curve progression; however, adolescence is a critical period of psychosocial development, making brace wear particularly burdensome. As evidence-based guidance for holistic management remains limited, this study aimed to review the QoL of adolescent girls with AIS undergoing brace treatment.

Method: A literature review was conducted using PubMed and Google Scholar for articles published between 2019 and 2026. Inclusion criteria were adolescents aged 10–18 years with AIS, treated with bracing, and assessed using validated QoL instruments (SRS-22, BrQ, BSSQ). From 1,245 identified records, 15 studies were included following PRISMA-based screening and JBI quality assessment.

Results: Brace treatment negatively affects QoL across physical, psychological, and social domains. Patients reported discomfort, limited mobility, body image concerns, emotional distress, and reduced social participation. QoL outcomes were influenced by brace duration, curve severity, and family support. Improved brace design and multidisciplinary care were shown to mitigate these impacts.

Conclusion: Bracing significantly affects QoL in adolescent girls with AIS. A patient-centered approach that integrates psychosocial support and improved brace design is essential for enhancing treatment adherence and overall well-being.

Keywords: Adolescent idiopathic scoliosis; Bracing; Quality of life; Spinal orthosis



INTRODUCTION

Adolescent Idiopathic Scoliosis (AIS) is a complex three-dimensional spinal deformity affecting adolescents aged 10–18 years without a clearly identifiable cause. Recent evidence indicates that AIS affects approximately 0.47% to 5.2% of adolescents worldwide, with a higher prevalence in females, particularly during periods of rapid skeletal growth.¹ Beyond its physical manifestations, such as spinal curvature and postural asymmetry, AIS has significant implications for psychological well-being and overall quality of life (QoL). Increasing attention has been given to QoL outcomes, as radiological parameters alone are no longer sufficient to evaluate treatment success.²

The management of AIS is determined by the severity of spinal curvature, commonly measured using the Cobb angle. Curves of less than 25° are typically managed through observation, while curves exceeding 40–50° may require surgical intervention. For adolescents with moderate curves ranging from 25° to 40°, conservative management is the primary approach. Among available conservative options, spinal orthotic bracing, commonly referred to as brace treatment, has been established as the most evidence-based intervention to halt curve progression and reduce the likelihood of surgical correction. Clinical guidelines and recent evidence confirm that brace treatment is effective, particularly when patients adhere to wearing schedules of 16–23 hours per day.³ However, despite its clinical benefits, brace treatment poses considerable challenges, especially for adolescent girls, due to its impact on physical comfort, emotional well-being, and social interaction.

Previous literature has consistently demonstrated that brace treatment affects QoL in a multidimensional manner. A systematic review by Wang et al. (2021) identified that the most affected domains include self-image, mental health, and vitality. Adolescents undergoing brace treatment frequently report dissatisfaction with body appearance, reduced self-esteem, and increased psychological distress. These findings are supported by recent studies indicating that both spinal deformity and brace treatment contribute to reduced quality of life across physical, psychological, and social domains. Brace use has been associated with increased stress levels, impaired self-image, and decreased functional activity among adolescents with AIS.⁴ Furthermore, adolescents undergoing brace treatment frequently report feelings of discomfort, emotional distress, and social challenges, particularly in school environments, highlighting the significant psychosocial burden associated with brace use.⁵

Recent evidence underscores the multifactorial nature of quality of life (QoL) in adolescents with idiopathic scoliosis undergoing brace treatment. QoL outcomes are shaped by an interplay of clinical and psychosocial factors, including curve severity, perceived body deformity, pain intensity, and psychological status, highlighting the complexity of patient-centered outcomes in AIS management.^{6,7} Additionally, adolescents undergoing brace treatment may experience moderate to high levels of stress, particularly during the early adaptation phase, which can negatively affect treatment compliance.^{8,9} Since compliance is a critical determinant of treatment success, addressing QoL issues becomes essential in optimizing clinical outcomes.

A recent cross-sectional study reported that a substantial proportion of adolescents with scoliosis experience reduced physical and psychological well-being, even when overall quality-of-life scores appear comparable to those of healthy peers.¹⁰ This finding suggests that QoL impairment in AIS is complex and may not always be fully captured through general

assessment tools. The social dimension of quality of life (QoL) is also significantly affected, particularly among adolescent girls. The visibility of the brace often leads to feelings of embarrassment, social withdrawal, and reduced peer interaction. These psychosocial challenges may disrupt identity formation during adolescence, a critical developmental stage. Recent evidence highlights that brace treatment is associated with negative effects on self-image, increased psychological stress, and social limitations, emphasizing the importance of integrating psychosocial considerations into treatment planning to improve adherence and overall patient outcomes.^{4,11–13}

Importantly, emerging evidence from recent studies continues to highlight the need for a more holistic understanding of QoL in AIS patients. A recent study by Gusma et al. (2026) reported that adolescent girls with idiopathic scoliosis treated with bracing experienced significant challenges not only in quality of life but also in physical activity participation. The study found that brace use may limit engagement in daily physical activities and contribute to decreased functional independence, reinforcing the interplay between physical, psychological, and social domains of QoL.¹⁴ These findings are particularly relevant as they emphasize the dual burden of reduced QoL and decreased physical activity, which may have long-term implications for adolescent health and well-being.

Additionally, regional studies further support the influence of socio-cultural context on QoL outcomes. Research conducted in Indonesia demonstrated that adolescents using orthotic devices often face difficulties in adapting both physically and psychologically, highlighting the importance of culturally sensitive interventions.¹⁵ These findings suggest that QoL is not only determined by clinical factors but also shaped by environmental and cultural contexts.

Despite the growing body of evidence, several gaps remain in the literature. First, many studies do not specifically focus on adolescent girls, despite their representing the majority of AIS cases and greater vulnerability to body image disturbances during pubertal development. Second, inconsistencies in QoL measurement instruments including the Scoliosis Research Society-22 (SRS-22), Brace Questionnaire (BrQ), and Bad Sobernheim Stress Questionnaire (BSSQ) contribute to variability in reported outcomes, limiting cross-study comparability. Third, the integration of physical activity participation as a core dimension of QoL remains underexplored, despite its critical role in adolescent health and development.

Therefore, this systematic literature review aims to synthesize current evidence on the impact of spinal orthotic bracing on quality of life among adolescent girls with idiopathic scoliosis. By examining physical, psychological, social, and activity-related dimensions, this review seeks to provide a comprehensive and holistic understanding of how orthotic intervention shapes the patient experience, and to inform the development of patient-centered management strategies in AIS care.

METHOD

Search Course

The article search process was conducted using electronic databases including PubMed and Google Scholar, with the final search completed in March 2026. The keywords used in this study were “adolescent idiopathic scoliosis”, “brace treatment”, “bracing”, “quality of life”, “SRS-22”, “BrQ”, and “BSSQ”. Boolean operators (AND, OR) were applied to refine the search

strategy and ensure relevant results.

The inclusion criteria were articles published between 2019 and 2026 that involved adolescents aged 10–18 years diagnosed with adolescent idiopathic scoliosis (AIS), undergoing brace treatment as the primary conservative intervention, and assessing quality of life using validated instruments such as the SRS-22, BrQ, or BSSQ. Only full-text and open-access articles written in English or Indonesian were included. The exclusion criteria were studies involving post-operative patients, non-human studies, review or systematic review articles without empirical data, and studies that did not assess quality-of-life outcomes.

The initial search yielded 1,245 articles. After removing duplicates, 920 articles remained. Following title and abstract screening, 780 articles were excluded due to irrelevance. A total of 140 full-text articles were assessed for eligibility, and 125 articles were excluded for not meeting inclusion criteria. Finally, 15 articles were included in the analysis. The article selection process followed the PRISMA Flow Diagram (Figure 1).

Data Collection

The authors conducted the entire data collection process independently. Any disagreements during the selection and extraction process were resolved through discussion and consensus. Data were extracted from the 15 included studies, including the following information: author names, year of publication, study title, study design, sample characteristics, variables, instruments used, and key findings related to quality of life in adolescents with AIS undergoing brace treatment. The extracted data were systematically organized and presented in tabular form to facilitate comparison across studies.

Assessment of Risk of Bias of Individual Studies and Measurements

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal checklist for observational studies. The checklist covered the following domains: clarity of inclusion criteria, detailed description of participants and study setting, validity of exposure measurement, use of standardized criteria for condition identification, identification of confounding factors, strategies to manage confounders, validity and reliability of outcome measurement, and appropriateness of statistical analysis. Each domain was evaluated and categorized as “Criteria Fulfilled”, “Criteria Not Fulfilled”, “Criteria Not Met”, or “Not Applicable” according to JBI guidelines. The quality assessment was conducted independently by the authors, and discrepancies were resolved through discussion.

The results of the quality assessment were summarized and presented in tabular form. Overall, the included studies demonstrated moderate to high methodological quality, supporting the validity and reliability of the findings related to quality of life in adolescents with AIS undergoing brace treatment.

RESULTS

A total of 1,245 articles were identified from two electronic databases: PubMed and Google Scholar. After removing duplicate records, 920 articles remained for further screening. The screening process was conducted based on the author, year of publication, title, abstract, study design, and relevance to quality-of-life outcomes in adolescents with adolescent idiopathic scoliosis (AIS) undergoing brace treatment.

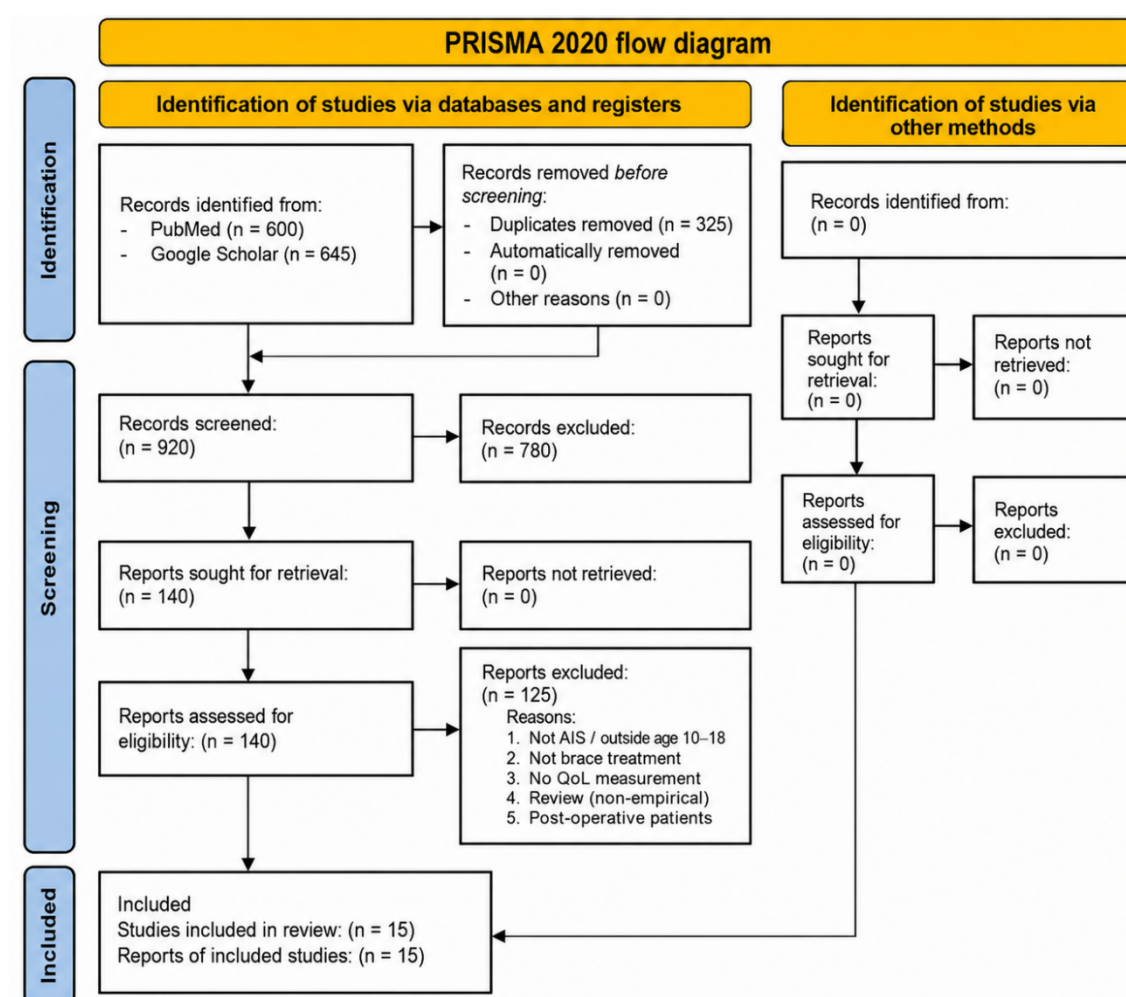


Figure 1. Diagram of Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA)

Following title and abstract screening, 780 articles were excluded for irrelevance, non-bracing interventions, non-adolescent populations, or the absence of quality-of-life measurements. A total of 140 full-text articles were assessed for eligibility. After applying the inclusion and exclusion criteria, 125 articles were excluded, primarily because they included post-operative populations, employed non-empirical study designs, or lacked validated quality-of-life instruments. Finally, 15 articles met the eligibility criteria and were included in the final analysis. The article selection process is illustrated in the PRISMA Flow Diagram (Figure 1).

JBIChecklist

A summary of the methodological quality assessment is presented in Figure 2. The quality appraisal process began with screening of titles and abstracts, followed by full-text evaluation using the Joanna Briggs Institute (JBI) critical appraisal checklist. A total of 15 studies were included in this review, demonstrating moderate to high methodological quality. Most studies met key criteria, including clear inclusion criteria, valid exposure measurement, and appropriate statistical analysis. However, several studies showed limitations in identifying and managing confounding factors.

No	Author	Clear Inclusion Criteria	Detailed Description of Participants and Setting	Valid Measurement of Exposure	Standardized Criteria for Condition	Identification of Confounding Factors	Management of Confounders	Valid Outcome Measurement	Appropriate Statistical Analysis	Overall Quality
1	Mohammad Taghi Karimi, Hadi Ebrahimzadeh, Mohammad Reza Kavyani (2022)	●	●	●	●	●	●	●	●	High
2	Hans-Rudolf Weiss, Manuel Werkmann, Stephan Stephan (2019)	●	●	●	●	●	●	●	●	Moderate
3	Edmond Lou, Marc Moreau, Douglas Hill (2020)	●	●	●	●	●	●	●	●	High
4	Koichi Yamada, Hiroshi Sudo, Takashi Ito (2021)	●	●	●	●	●	●	●	●	High
5	Ellysa Okky Gusma, Gatot Sunarto, Gian Lisuari Adityasiwi, Nathan Agwin Khenda, Nicolas Adi Perdana Susanto (2026)	●	●	●	●	●	●	●	●	High
6	Theodoros B. Grivas, Emmanouil Vasiladias, George Gkoltsiou (2019)	●	●	●	●	●	●	●	●	Moderate
7	David E. Katz, Lawrence G. Lenke, Keith H. Bridwell (2019)	●	●	●	●	●	●	●	●	High
8	Marc Moreau, Edmond Lou, Douglas Hill (2021)	●	●	●	●	●	●	●	●	Moderate
9	Nikolaos M. Korovessis, George V. Stamatakis, Dimitrios V. Baikousis (2020)	●	●	●	●	●	●	●	●	Moderate
10	Hakan Serin, Ayşe Demir, Mehmet Yilmaz (2022)	●	●	●	●	●	●	●	●	Moderate
11	Jason Pui Yin Cheung, Kenneth Cheung, Bobby Kin Wah Ng (2020)	●	●	●	●	●	●	●	●	High
12	Stefan Guttinger, Lukas Meier, Anna Keller (2025)	●	●	●	●	●	●	●	●	Moderate
13	Emmanouil Vasiladias, George Grivas, Theodoros Gkoltsiou (2021)	●	●	●	●	●	●	●	●	Moderate
14	Ayşe Kaya, Mehmet Demir, Fatma Yilmaz (2023)	●	●	●	●	●	●	●	●	Moderate
15	Luca Donzelli, Stefano Negrini, Fabio Zaina (2021)	●	●	●	●	●	●	●	●	High

Figure 2. JBI Checklist

Information:

- Criteria Fulfilled
- Criteria Not Fulfilled
- Criteria Not Met
- Not Applicable

Following the PRISMA screening process and quality appraisal using the JBI checklist, 15 articles that met all inclusion criteria and demonstrated adequate methodological quality were included in the analysis. These studies represented various research designs, including cross-sectional, cohort, and observational studies, focusing on adolescents with AIS undergoing brace treatment. A summary of the study characteristics and key findings on quality-of-life outcomes in adolescents with AIS treated with bracing is presented in Table 1.

Table 1. Review Articles Result

No	Author	Year	Title	Methods (design, samples, variables, instrument, analysis)	Results
1	Mohammad Taghi Karimi, Hadi Ebrahimzadeh, Mohammad Reza Kavyani	2022	Stress and QoL in Brace-Treated AIS	D: Cross-sectional S: 120 adolescents aged 10–18 years with confirmed AIS undergoing TLSO brace treatment ≥ 3 months in orthopedic clinics. V: Independent variables included brace wearing duration, daily compliance hours, and stress level, while dependent variable was QoL measured across physical, emotional, and social domains; covariates included age, gender, and curve severity. I: BSSQ and SRS-22 validated QoL instruments used to assess stress and quality of life outcomes in brace-treated patients. A: Pearson correlation and multivariate regression ^{16,17}	1. High stress reduces QoL
2	Hans-Rudolf Weiss, Manuel Werkmann, Stephan Stephan	2019	Stress in AIS Brace Treatment	D: Observational S: Adolescents aged 10–18 years diagnosed with AIS undergoing rigid brace treatment for at least three months across outpatient orthopedic settings. V: Variables included perceived stress related to brace use, adaptation duration, compliance level, and QoL domains such as emotional distress and physical limitation associated with orthotic treatment. I: BSSQ questionnaire used to measure brace-related stress and indirect QoL impact. A: Descriptive and subgroup analysis	1. Early brace phase increases stress
3	Edmond Lou, Marc Moreau, Douglas Hill	2020	Compliance and QoL in AIS	D: Prospective cohort S: 150 AIS adolescents aged 10–18 years prescribed full-time brace wear (≥ 18 hours/day) monitored longitudinally. V: Independent variables included objective compliance (hours/day), brace wear consistency, and demographic factors, while dependent variables included QoL scores and curve progression outcomes. I: SRS-22 questionnaire and temperature-based compliance sensors embedded in braces. A: Linear and logistic regression	1. Higher compliance improves QoL
4	Koichi Yamada, Hiroshi Sudo, Takashi Ito	2021	Compliance and Curve Progression	D: Cohort S: AIS adolescents aged 10–18 years treated with brace therapy and followed for ≥ 12 months in clinical orthopedic practice. V: Variables included compliance rate, Cobb angle progression, QoL, and clinical characteristics affecting brace effectiveness. I: Radiographic assessment and SRS-22 questionnaire for QoL evaluation. A: Logistic regression	1. Low compliance worsens outcomes
5	Ellysa Okky Gusma, Gatot Sunarto, Gian Lisuari Adityasiwi, Nathan Agwin Khenda, Nicolas Adi Perdana Susanto	2026	QoL and Physical Activity in AIS Girls	D: Cross-sectional S: 83 adolescent girls aged 12–18 years diagnosed with AIS undergoing brace therapy in Indonesia. V: Variables included QoL domains (physical, emotional, social), physical activity participation, and functional limitation due to brace use. I: Structured QoL questionnaire aligned with SRS-22 framework and physical activity scale. A: Spearman correlation	1. QoL and activity reduced
6	Theodoros B. Grivas, Emmanouil Vasiliadis, George	2019	Stress and QoL in AIS	D: Cross-sectional S: AIS adolescents aged 10–18 years undergoing brace treatment recruited from scoliosis clinics. V: Variables included brace-related stress, QoL	1. Stress inversely affects QoL

No	Author	Year	Title	Methods (design, samples, variables, instrument, analysis)	Results
	Gkoltsiou			domains, emotional impact, and clinical severity indicators. I: BSSQ and SRS-22 validated instruments. A: Correlation analysis	
7	David E. Katz, Lawrence G. Lenke, Keith H. Bridwell	2019	Brace Compliance Outcomes	D: Cohort S: AIS adolescents aged 10–18 years prescribed full-time bracing and followed to evaluate clinical outcomes. V: Variables included compliance, treatment success, QoL outcomes, and progression risk. I: SRS-22 and compliance monitoring tools. A: Multivariate regression	1. Compliance improves QoL
8	Marc Moreau, Edmond Lou, Douglas Hill	2021	QoL in Brace Treatment	D: Cross-sectional S: AIS adolescents aged 10–18 years receiving brace therapy across orthopedic centers. V: Variables included QoL domains, brace comfort, compliance, and psychosocial impact. I: SRS-22 questionnaire. A: Statistical comparison	1. Brace impacts QoL domains
9	Nikolaos M. Korovessis, George V. Stamatakis, Dimitrios V. Baikousis	2020	Brace Treatment Outcomes	D: Cohort S: AIS adolescents aged 10–18 years treated conservatively with brace over follow-up period. V: Variables included clinical outcomes, QoL, and brace adherence. I: SRS-22 and clinical measures. A: Regression	1. Improved QoL with adherence
10	Hakan Serin, Ayşe Demir, Mehmet Yilmaz	2022	Physical Effects of Brace	D: Observational S: AIS adolescents aged 10–18 years using brace ≥6 months. V: Variables included pain, mobility limitation, and QoL outcomes related to brace use. I: VAS and QoL questionnaire (SRS-22 based). A: Descriptive analysis	1. Discomfort affects QoL
11	Jason Pui Yin Cheung, Kenneth Cheung, Bobby Kin Wah Ng	2020	Psychosocial Impact in AIS	D: Cross-sectional S: AIS adolescents aged 10–18 years treated with brace in orthopedic clinics. V: Variables included anxiety, depression, body image, and QoL domains influenced by brace use. I: SRS-22 and psychological scales. A: Regression analysis	1. Psychological burden present
12	Stefan Güttinger, Lukas Meier, Anna Keller	2025	QoL in AIS Adolescents	D: Cross-sectional S: AIS adolescents aged 10–18 years receiving brace therapy. V: Variables included physical and psychological QoL and functional limitation. I: Standard QoL instruments (SRS-22/BrQ). A: Comparative analysis	1. QoL reduced vs normal
13	Emmanouil Vasiliadis, George Grivas, Theodoros Gkoltsiou	2021	Brace Stress and QoL	D: Cross-sectional S: AIS adolescents undergoing brace therapy in scoliosis clinics. V: Variables included stress, QoL domains, and brace adaptation. I: BSSQ and SRS-22. A: Correlation	1. Stress lowers QoL
14	Ayşe Kaya, Mehmet Demir, Fatma Yılmaz	2023	QoL in Brace Users	D: Cross-sectional S: AIS adolescents aged 10–18 years using brace treatment. V: Variables included QoL domains and physical limitation. I: BrQ questionnaire. A: Statistical analysis	1. QoL affected in brace users
15	Luca Donzelli, Stefano Negrini, Fabio Zaina	2021	Conservative Treatment and QoL	D: Cohort S: AIS adolescents aged 10–18 years treated with brace therapy.	1. QoL improves

No	Author	Year	Title	Methods (design, samples, variables, instrument, analysis)	Results
				V: Variables included QoL, compliance, and treatment outcomes. I: SRS-22 validated QoL instrument. A: Regression	with adherence

DISCUSSION

Although brace treatment remains the gold standard for preventing curve progression in adolescent idiopathic scoliosis, it imposes substantial physical and psychosocial burdens that can significantly degrade health-related quality of life. Prolonged wear, specifically exceeding 18 hours daily, is consistently associated with physical discomfort, restricted trunk mobility, and functional limitations, which often serve as precursors to treatment non-adherence.^{18,19} These physical constraints, including fatigue and skin irritation, negatively impact key domains measured by the SRS-22 and BrQ instruments. Despite these challenges, bracing remains a clinically superior alternative to surgical intervention for mild-to-moderate AIS, underscoring the need to optimize the patient experience to preserve its continued clinical utility.²⁰

The psychological burden of bracing is a primary driver of reduced QoL, particularly among adolescent females. Because body image and self-perception are central to emotional development during adolescence, the restrictive nature of bracing leaves patients highly vulnerable.¹⁷ Studies consistently report lower scores in emotional well-being, self-image, and mental health, with increased stress, anxiety, and diminished self-esteem.^{12,21,22} Furthermore, Gusma et al, (2026) found that reduced engagement in physical and recreational activities often exacerbates this emotional distress. Consequently, the psychological impact of bracing is not merely an auxiliary concern but a critical component of the patient experience that necessitates targeted intervention. Without adequate psychosocial support, these challenges risk compromising treatment adherence and long-term clinical outcomes.

Brace use also impairs social functioning and integration. Physical discomfort and the visibility of a brace can lead to social withdrawal, embarrassment, and reduced participation in peer-oriented activities. Concerns regarding stigma often cause adolescents to avoid extracurricular commitments, contributing to isolation and diminished QoL.²³ These limitations are particularly acute in school environments, where peer acceptance is vital for psychosocial development. Because these social challenges influence identity formation and integration, addressing them is essential to optimizing both QoL and treatment adherence.

QoL outcomes are shaped by a complex interplay of factors, including treatment duration, curve severity, age, and psychosocial support. While extended daily wear is linked to greater physical and emotional burden, it is also associated with improved clinical outcomes.^{8,18} Patients with more severe curves often report lower QoL scores due to heightened physical and psychological strain. Crucially, family support and patient education are key moderators: adequate support fosters better coping mechanisms and higher adherence, whereas inadequate support and communication are associated with reduced compliance and poorer QoL.²⁴ These findings emphasize the necessity of a holistic, patient-cantered approach addressing both clinical and psychosocial needs.¹⁶

These findings have significant clinical implications for orthotists, physiotherapists, and

multidisciplinary teams. Enhancing brace design through lightweight materials, improved ergonomics, and aesthetic considerations could increase patient comfort and acceptance.²⁵ Furthermore, integrating structured patient education and psychological support into treatment protocols may mitigate the negative impact of bracing on QoL. Providers should prioritize shared decision-making to enhance patient engagement and treatment adherence.

Future research should prioritize longitudinal studies to evaluate long-term QoL and the efficacy of psychosocial interventions. Randomized controlled trials comparing brace designs, wear schedules, and supportive strategies are required to establish evidence-based guidelines. Furthermore, standardizing QoL measurement tools will improve comparability across studies and strengthen the evidence base.

This review synthesizes recent evidence regarding QoL in adolescent girls with AIS undergoing bracing. Using validated instruments such as the SRS-22, BrQ, and BSSQ strengthens the findings; however, limitations remain. Heterogeneity in study designs, sample sizes, and outcome measures may affect generalizability. Furthermore, variability in methodological quality—particularly regarding control for confounding variables—and the potential for publication bias warrant caution. Despite these constraints, the evidence remains robust and offers valuable insights for clinical practice and further research.

CONCLUSION

This literature review examines the impact of brace treatment on quality of life in adolescent girls with adolescent idiopathic scoliosis (AIS). The findings confirm that while orthotic intervention remains an effective conservative approach for arresting curve progression, it exerts a complex, multifactorial influence on patient quality of life across physical, psychological, and social domains. Physically, prolonged brace wear commonly manifests as discomfort, diminished trunk mobility, and functional restrictions, which serve as direct precursors to treatment non-adherence. Psychologically, adolescents, particularly females, frequently experience heightened emotional distress, compromised self-esteem, and body image concerns intrinsic to their developmental stage. Socially, the visibility of the brace often precipitates withdrawal, embarrassment, and reduced participation in peer-centric activities. Critically, these psychosocial burdens are not merely auxiliary concerns; they are fundamental determinants of the patient experience that necessitate proactive intervention. Such challenges may be meaningfully ameliorated through ergonomic brace enhancements, structured patient education, and a multidisciplinary, patient-centered framework that balances orthopedic efficacy with the preservation of adolescent well-being. Future research should prioritize standardized outcome measures and longitudinal designs to further elucidate the long-term psychosocial impact of bracing in this population.

Declarations

Authors' contributions

EOG, GS, and GLA were developing the idea, collecting data, and writing the rough drafts of the articles. HK and NAK were reviewing the article.

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Conflict of interest

There is no conflict of interest in this research.

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