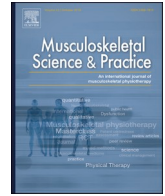




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Original article

## Factors influencing of quality of life in adolescent idiopathic scoliosis

Mehmet Hanifi Kaya<sup>a,\*</sup>, Fatih Erbahçeci<sup>b</sup>, Halil Alkan<sup>c</sup>, Hikmet Kocaman<sup>d</sup>, Buket Büyükturan<sup>e</sup>, Mehmet Canlı<sup>e</sup>, Öznur Büyükturan<sup>e</sup><sup>a</sup> Kırşehir Ahi Evran University, Faculty of Medicine, Kırşehir, Türkiye<sup>b</sup> Hacettepe University, Faculty of Physiotherapy and Rehabilitation, Department of Musculoskeletal Rehabilitation, Ankara, Türkiye<sup>c</sup> Muş Alpaslan University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Muş, Türkiye<sup>d</sup> Karamanoğlu Mehmet Bey University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Karaman, Türkiye<sup>e</sup> Kırşehir Ahi Evran University, School of Physical Therapy and Rehabilitation, Kırşehir, Türkiye

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## ABSTRACT

**Background:** Adolescent idiopathic scoliosis (AIS) is the lateral and horizontal deformity of the vertebral column which occurs idiopathically during adolescence. The aim of this study is to identify independent predictors of quality of life in AIS patients.**Methods:** In total, 31 adolescent patients diagnosed with AIS aged between 10 and 18 years old were included in the study. The scoliosis severity was determined for each patient according to the Cobb method, and their scoliosis perception using the Walter Reed Visual Assessment Scale, a pain assessment was conducted based on the Visual Analog Scale, quality of life using the Scoliosis Research Society-22 questionnaire, and depression level according to the Children's Depression Scale. Multiple Linear Regression analysis was then performed in order to determine the independent determinants of health-related quality of life.**Findings:** According to the Linear Regression analysis results, children's depression scale, walter reed visual assessment scale, cobb, and anterior trunk rotation explained 52.7% of the variance as independent determinants of SRS-22.**Interpretation:** The study examined the determinants affecting the quality of life in AIS patients. The results of the study showed that scoliosis severity, perception of cosmetic deformity, degree of rotation, and depression level to be predictors of quality of life in AIS patients. "This trail registered with NCT05242601."

## 1. Introduction

Adolescent idiopathic scoliosis (AIS) is defined as three-dimensional torsional deformity characterized by greater than 10° lateral deviation of the spine, with vertebral rotation and reduced normal thoracic kyphosis (Grivas et al., 2006; Negrini et al., 2012a). AIS is the most common type of scoliosis. The condition begins in early puberty, affecting 1–4% of adolescents, and is more common in females aged 10–18 years old (Cheng et al., 2015).

Quality of life is an important in adolescence. Examples of the physical problems caused by AIS related to quality of life are back pain, impaired spinal flexibility, postural abnormality, and cosmetic trunk deformity (Miller, 1999). Continued advances in the research on quality of life have led to the recognition that more attention needs to be paid not only to the rate of surgical correction, but to their quality of life as patients with AIS and their perceptions of deformity (Danielsson et al.,

2001). In a study which evaluated the quality of life in patients with AIS according to the SRS-22 questionnaire, Colak et al. stated that Cobb angle affects patients quality of life (Çolak et al., 2017). In another study, Schwieger et al. (2016) examined the effects of brace treatment on quality of life in AIS patients according to the Pediatric Quality of Life Inventory 4.0 Generic Scales. In a study by Koca et al. the Schroth method and core stabilization exercises were compared, and it was reported that the participants' SRS-22 values in the Schroth method group were more significant than those in the core stabilization exercises group (Kocaman et al., 2021). Kaya et al. examined the relationship between scoliosis severity and quality of life and evaluated the quality of life with SRS-22. According to their research, a relationship was found between the severity of scoliosis and quality of life, and it was reported that as the severity of scoliosis increased, the quality of life decreased (Mehmet Hanifi Kaya et al., 2021).

To date, no study has been found in the literature that has

\* Corresponding author. Kırşehir Ahi Evran University, Faculty of Medicine, Türkiye.

E-mail address: [m.kaya@ahievran.edu.tr](mailto:m.kaya@ahievran.edu.tr) (M.H. Kaya).

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investigated the factors affecting quality of life in AIS patients. Knowing the independent predictors that affect the quality of life in AIS is important for the clinician to apply more accurate treatment and to minimize future problems. In addition to the importance of the degree of scoliosis in the treatment, it will be beneficial to develop a more holistic treatment approach that other parameters should not be ignored in the treatment of individuals with AIS. In the literature, there are studies examining the quality of life in AIS. However, to date, it is not yet known what independent predictors of quality of life are the SRS-22 questionnaire is frequently used when assessing quality of life in AIS. This questionnaire is valid-reliable and its Turkish version is made by Alanay et al. (2005). To the best of our knowledge, there is no study in literature that has investigated the predictive factors affecting quality of life in AIS. Therefore, the aim of the current study is to identify independent predictors of quality of life assessed with SRS-22 in AIS patients.

## 2. Methods

### 2.1. Study design

The hypothesis of this study was to determine the factors influencing of Quality of Life in patients with AIS. The study was conducted between September and December of 2021, and was undertaken having received approval from the university's ethics committee (decision: 2021-06/31). Written and verbal consent was obtained from each of the study's participants and their parents (as under 18 years of age) prior to the start of the study. The study was undertaken in accordance with the principles of the Declaration of Helsinki. The authors confirm that all ongoing and relevant studies have been registered for this study. This study design was cross sectional. To date, to our knowledge, the possible factors that influence the SRS-22 have not been investigated in adolescent. Nevertheless, a previous study showed that Cobb angle is a significant determinant of quality of life in adult scoliosis ( $R^2: 0.30, p < .05$ ) (Parent et al., 2010). Based on the findings of that study, the minimum required sample size for a linear regression analysis was calculated as 29 participants for the probability level of 0.05; for the 6 determinants (Quality of Life, Anterior Trunk Rotation, Pain, Scoliosis Severity, Cosmetic Deformity Perception, Depression Level) with G\*Power Software v3.1.9.2 (Faul et al., 2007).

### 2.2. Participants

The study's participants were adolescents with a diagnosis of AIS, according to the Lenke criteria, and had previously been referred to the XXX University School of Physical Therapy and Rehabilitation for exercise therapy. Inclusion criteria for the study were that the study participants volunteered to be subjects of this research, that they had been diagnosed with AIS, were aged 10–18 years old at the time of the study, had a Cobb angle of 10–30°, and were of Lenke Curve Type 1 (Lenke, 2005). Prospective participants were excluded from the study where they had non-idiopathic scoliosis, exercise contraindications, had previously received orthotic treatment for scoliosis or had undergone spinal surgery, or had other neuromuscular, cardiopulmonary, or rheumatological problems.

### 2.3. Measurements

Sociodemographic data were collected through face-to-face interviews. The participants' Cobb angle, trunk rotation angle, cosmetic trunk deformity, and quality of life were each evaluated by the same researcher (MHK) who conducted the interview.

## 3. Outcome measurement

### 3.1. quality of life

The Scoliosis Research Society-22 (SRS-22) questionnaire was used to assess the participants' quality of life. The SRS-22 questionnaire is considered to be a valid self-report tool used in the assessment of scoliosis-related quality of life. The questionnaire consists of five domains: "Self-image," "Function," "Pain," "Mental health" (five questions each), and "Satisfaction with treatment" (two questions). The questionnaire has a total of 22 items which are each scored from "1" (worst) to "5" (best). The final score is the average taken across the five domain areas. The SRS-22 tool has been reported to possess a good level of validity and test-retest reliability (Caronni et al., 2014).

### 3.2. Anterior trunk rotation (ATR)

The participants patients' ATR was assessed using Bunnell's Scoliometer and Adam's Forward Bend Test. Each participant was requested to bend forward, and the trunk rotation angle was then measured according to the apical vertebrae of the curve. The change in ATR must be  $> 4^\circ$  in order to be considered clinically significant. This measurement has been proven to be sensitive, specific, and reliable (Amendt et al., 1990).

### 3.3. Pain

The Visual Analog Scale (VAS) was used to assess the pain status of each participant. The scale was designed so as to document the characteristics of disease-related symptom severity in patients, and has been proven to be both valid and reliable (Bijur et al., 2001). The VAS consists of a 10 cm (cm) line that has a value of "10" at one end that indicates a maximum pain level and a value of "0" at the other end denoting zero pain (Bijur et al., 2001). The individual participants were each asked to mark a place on the scale according to their pain state at rest, during activity, and at night. The values were each recorded as cm values.

### 3.4. scoliosis severity

The angular value of the AIS patients' curvature was measured using the Cobb method with anteroposterior spinal radiograph, and the resulting value recorded in degrees. The angle between the lines drawn perpendicular to the tangents from the upper boundary of the top vertebra and the lower boundary of the bottom vertebrae is taken as the Cobb angle. In the literature, Cobb angle is considered the gold standard for determining the magnitude of spinal curvature on the anteroposterior spinal radiograph (Prujjs et al., 1994).

### 3.5. Cosmetic Deformity Perception

The Walter Reed Visual Assessment Scale (WRVAS) is a scale of visual expressions designed to describe how patients with AIS perceive their own deformity. The first version was created in 2003 by Sanders Deformity according to seven different aspects (Sanders et al., 2003) with each of the seven containing a set of five figures representing the severity of the deformity. Each item is scored from "1" to "5," with higher scores reflecting an increased level of deformity (Pineda et al., 2006; Bago et al., 2007). Results are presented as the sum of all seven items. The WRVAS scale was administered in the current study as a patient self-assessment tool.

### 3.6. depression level

The Children's Depression Scale is a self-assessment tool used with children aged 6–17 years old for the evaluation and investigation of childhood depression. The scale was developed by Kovacs based on the

Beck Depression Scale (Munkácsi et al., 2018), and was adapted into Turkish by Oy in 1991. The scale consists of 27 items, each with three score options of “0,” “1,” and “2,” to indicate the severity of a symptom of depression experienced by a subject during the preceding 2 week period. The total score achievable for the scale ranges from 0 to 54 (Oy, 1991).

3.7. Statistical analysis

IBM’s Statistical Package for Social Science (SPSS) version 22.0 was used in the analysis of the collected data. Normality of the data was analyzed using both visual (histogram and probability graphs) and analytical (Kolmogorov-Smirnov, Shapiro Wilk) methods of testing. Descriptive statistical information was given as mean and standard deviation ( $X \pm SD$ ), as well as minimum and maximum values. Pearson correlation analysis was used to calculate the correlation between the variables as the data was found to be normally distributed. In the study, linear regression analysis ( $R^2$ ) was performed in order to examine the factors most likely to affect quality of life in scoliosis patients.

4. Results

The demographic information of the study’s participants and the mean of the evaluation parameters are presented in Table 1. In addition the cases were included study as 22 female and 9 male.

The relationship between each variable is presented in Table 2. A statistically significant negative correlation was found between the participants’ SRS-22 scores and CDS ( $r = -0.586, p = .001$ ), whereas a negative correlation was found between the SRS-22 scores and ATR ( $r = -0.380, p = .035$ ). A negative correlation was found between the patients’ SRS-22 scores and Cobb ( $r = -0.484, p = .006$ ), whilst a negative correlation was found between their SRS-22 scores and WRVAS ( $r = -0.675, p = .000$ ). Notably, there was no significant relationship found to exist between the participants’ SRS-22 scores and the other evaluation parameters ( $p > .005$ ).

According to the Linear Regression analysis results (see Table 3), CDS, WRVAS, Cobb, ATR together explained 52.7% of the variance as independent determinants of the participant patients’ SRS-22 scores ( $p < .05$ ).

5. Discussion

According to the current study’s results, a significant relationship was revealed between the quality of life score, Cobb angle value, perception of deformity, and the depression levels of individuals with AIS. These results indicate that quality of life is negatively affected by

Table 1 Demographic and clinical characteristics of the participants.

	$X \pm SD$	Min	Max
Age (years)	14.22 ± 2.15	10	17
Height (cm)	163.70 ± 10.51	138	183
Weight (kg)	53.83 ± 13.18	27	89
BMI (kg/m <sup>2</sup> )	19.83 ± 3.28	13.20	26.87
VAS	2.87 ± 0.80	1	5
CDS	49.21 ± 2.82	43	54
ATR (°)	4.25 ± 2.11	1	12
Cobb (°)	14.61 ± 4.44	10	25
WRVAS	9.87 ± 2.43	7	15
SRS-22	4.40 ± 0.20	3.90	4.70
Gender		n	%
	Male	9	29,03
	Female	22	70,97

Cm: Centimeter, Kg: kilogram, BMI: Body Mass Index, °: degree, VAS: Visual Analog Scale, CDS: Child Depression Scale, ATR: Anterior Trunk Rotation, WRVAS: Walter Reed Visual Assessment Scale, SRS-22: Scoliosis Research Society questionnaire.

Table 2 Correlation between SRS-22 scores and other assessments.

	WRVAS	Cobb (°)	ATR (°)	CDS	VAS	SRS-22
SRS-22	$r = -0.675$ $p < .001$	$r = -0.484$ $p = .006$	$r = -0.380$ $p = .035$	$r = -0.586$ $p = .001$	$r = .272$ $p = .139$	-
VAS	$r = -0.098$ $p = .599$	$r = -0.107$ $p = .565$	$r = -0.039$ $p = .837$	$r = -0.094$ $p = .616$	-	-
CDS	$r = -0.441$ $p = .013$	$r = -0.173$ $p = .352$	$r = -0.089$ $p = .635$	-	-	-
ATR (°)	$r = -0.354$ $p = .051$	$r = -0.738$ $p = .000$	-	-	-	-
Cobb (°)	$r = -0.657$ $p = .000$	-	-	-	-	-
WRVAS	-	-	-	-	-	-

°: degree, VAS: Visual Analog Scale, CDS: Child Depression Scale, ATR: Anterior Trunk Rotation, WRVAS: Walter Reed Visual Assessment Scale, SRS-22: Scoliosis Research Society questionnaire.

Table 3 Linear regression model of SRS-22.

Variable	B	SE	Beta	p
Constant	3.715	.515	-	.000
CDS	0.022	-.008	.368	.016
ATR (°)	-0.020	.018	-.215	.276
Cobb (°)	0.002	.011	.044	.858
WRVAS	-0.040	.017	-.466	.023

$R = 0.768, R^2 = 0.590, Adjusted R^2 = 0.527.$

B: unstandardized regression coefficient. SE: Standard Error.

°: degree, VAS: Visual Analog Scale, CDS: Child Depression Scale, ATR: Anterior Trunk Rotation, WRVAS: Walter Reed Visual Assessment Scale, SRS-22: Scoliosis Research Society questionnaire.

Formula:  $[SRS = 3.715 + (0.022 \times CDS) + (-0.020 \times ATR) + (0.002 \times Cobb) + (-0.040 \times WRVAS)]$ .

AIS patients’ perception of deformity, psychological state, and curve magnitude. However, no statistically significant relationship was found to exist between the AIS patients’ SRS-22 and VAS scores. In addition, severity of spinal curvature, perception of cosmetic deformity, level of depression, and severity of rotation were each found to be independent predictors of quality of life in scoliosis patients.

In the literature, there are some studies evaluating the quality of life in cases diagnosed with AIS and treated conservatively. These studies have shown that the quality of life of individuals treated conservatively is also positively affected by the positive changes in the Cobb angle after the treatment. According to the results of these studies, it can be concluded that the decrease in the Cobb angle in the literature affects the quality of life positively (Caronni et al., 2014; Vasiliadis and Grivas, 2008; Negrini et al., 2012b; Schreiber et al., 2015). The current study found that quality of life and Cobb value had a negatively significant and moderate level or correlation. In other words, in accordance with the literature, we can say that the increase in the Cobb angle negatively affects the quality of life in AIS.

Anwer et al. In a systematic review study that investigated the effect of exercise practices, one of the important parameters of the conservative treatment of AIS, with moderate level of evidence, it was determined that exercise practice reduced Cobb angle and ATR with a moderate effect width and increased the quality of life. (Anwer et al., 2015). Similarly, Schreiber et al. examined the quality of life in individuals with AIS who were exercised in their study and found that exercise practice increased the quality of life. (Schreiber et al., 2015). Yagci et al. In their study, core exercises were applied to patients with AIS, and an improvement was detected in trunk rotation and body

symmetry in thoracic and lumbar Cobb angles. Likewise, they found an improvement in the part of the quality of life related to pain. (Yagci and Yakut, 2019). According to the study of Kuru et al. there was no significant change in the quality of life of patients with AIS who underwent Schroth exercise. (Kuru et al., 2016). The previous study made by our research team, we detected a relationship between Cobb angle and quality of life. We showed that an increase in Cobb grade negatively affects quality of life. (Mehmet Hanifi Kaya et al., 2021). According to the aforementioned study quality of life in individuals with AIS is a concept that can be affected and associated with many factors and can emerge as a predictive factor.

In a study by Schanz (Reichel and Schanz, 2003), the incidence of psychological disorders was found to be 19% in individuals with AIS. As such, AIS can be said to present an important risk factor for psychological disorders and poor quality of life (Eliason and Richman, 1984). Korovessis et al. (2007) mentioned that as patient ages increased, they were reportedly more ashamed of their body shape, and became more concerned about their future appearance. In another study conducted that compared the depression levels of patients with AIS and juvenile idiopathic scoliosis patients to determine factors affecting the degree of depression, it was found that the severity of depression increased as the curve magnitude increased, and that female patients in both groups tended to experience depression more than male patients (Lin et al., 2019). Climent et al. They examined how different types of braces affect quality of life, including psychosocial functionality, sleep disorders, body image, and back flexibility in patients with AIS. They showed that the braces reduces the quality of life, and the effect of brace treatment on the quality of life in patients with high Cobb angles is greater than in patients with less severe curvature. (Climent and Sánchez, 1999). According to some researchers, especially in the first period of brace treatment, the quality of life decreases significantly, but this effect decreases afterwards. (Climent and Sánchez, 1999; MacLean et al., 1989). Although we did not include individuals using brace in this study, using brace is an important parameter of conservative treatment, which is known to have significant effects on quality of life. In the current study, CDS was used to evaluate the psychological status of the participant AIS patients and it was found that SRS-22 and CDS scores showed a significant and negative correlation to each other. In this context, the results of the current study can be said to be compatible with that of the current literature.

The primary goal of scoliosis treatment, as clearly stated in the consensus of SOSORT, is to improve the patient's cosmetic appearance of the spine and posture (Negrini et al., 2006). Pineda et al. (2006) found that WRVAS scores were sensitive to changes due to worsening or improved scoliosis deformity. As stated in the 2005 consensus, only 5% of studies on scoliosis included a measure of esthetic appearance, whilst only 1.4% included quality of life (Negrini et al., 2006). The study by Savvides et al. shows that individuals with idiopathic scoliosis are more concerned about their body appearance than individuals without scoliosis (Savvides et al., 2020). When other studies evaluating quality of life were examined, it was reported that when the thoracic curve was more than 40° and trunk rotation was more than 20°, patients had a negative self-image related to their back appearance and low quality of life. (Pineda et al., 2006; Bago et al., 2007; Watanabe et al., 2005). The scarcity of studies on this subject makes it difficult to compare the results of the current study with others in the literature. According to the findings of the current study, a negative and significant relationship was found to exist between AIS Patients' SRS-22 scores, which evaluates their quality of life, and their WRVAS scores, which evaluates their perception of cosmetic deformity.

In the current study, a statistically significant and negative correlation was found to exist between the patients' ATR and SRS-22 scores. So, we observed that individuals with low ATR have a higher quality of life. Rracaj-Malaj et al. (Rracaj-Malaj et al., 2020) found that ATR and quality of life changed positively as the subject's Cobb angle reduced in a study in which they applied Schroth and Pilates treatment for a period

of 24 weeks with AIS patients. According to a meta-analysis study by Park et al. positive effects of exercise practices on ATR and quality of life in patients with idiopathic scoliosis were shown (Park et al., 2017). In a study conducted by Yagci et al. (Yagci and Yakut, 2019) in 2019, the authors examined the efficacy of two different exercise concepts in patients with AIS, thoracic and lumbar. Their results showed that ATR decreased statistically as a result of the applied treatment; however, no statistically significant change was seen in the patients' quality of life in either group, which was evaluated using the SRS-22 questionnaire. Despite an extensive literature review, no published studies were found which presented a relationship between ATR and SRS-22 scores, as the results of studies in this area are unclear. In this context, further studies are needed in order to determine how ATR and quality of life changes, and how each are affected in patients with AIS.

In a study conducted by Thérout et al. (2017), it was reported that 68% of individuals with AIS experienced pain, and that the pain was seen especially in the patients' primary curvature. It has also been reported that greater spinal deformity in cases of spinal pain is associated with higher levels of pain intensity. In another study, it was reported that back pain is more common in individuals with AIS than healthy individuals, and that the frequency of recurrence was shown to be higher (Sato et al., 2011). On the other hand, several other studies reported that incidences of lower back pain in patients with AIS was found to be nominal. Therefore, it may be said that differing opinions exist on this issue in the literature. According to the aforementioned studies, the relationship between AIS and pain has yet to be clearly defined. In this context, the results obtained from the current study may be seen as providing important information in terms of an additional contribution to the literature (Sato et al., 2011; Fortin et al., 2016; Wilson et al., 2002).

When the literature was examined, the researchers could find no studies that examined the independent predictors of quality of life in AIS patients. In the current study, Cobb, WRVAS, CDS, and ATR values were each found to be independent predictors of quality of life in AIS patients and together represented 52.7% of the variance found.

## 6. Study limitation

The fact that the participants' Cobb degrees in the current study were between 10 and 30°, and that participants with different degree values were excluded from the study may be considered a limitation of the study. However, the study was conducted among participants with Lenke Type 1 curvature which suggests that the results may vary in patients presenting different curvature types and different Cobb degrees. Therefore, further studies are required in order to further the literature on this subject. In the literature, it is known that the gender progression factors of scoliosis vary according to age and the degree of curvature. It is known that scoliosis disease is more common in girls than boys in the change according to gender. Reliable sources say that the ratio of girls to boys is 1.5–7.2 (Konieczny et al., 2013), depending on age and Cobb angle. In our study, we included individuals with AIS at a ratio of 3:7, which is consistent with the literature. However, in the regression analysis, it was not seen that gender had a predictive effect on SRS-22.

## 7. Conclusion

The current study examined the determinants affecting the quality of life in AIS patients. The results of the study found that scoliosis severity, perception of cosmetic deformity, degree of rotation, and depression level were quality of life predictors in AIS patients. Since the factors affecting quality of life in AIS patients are interrelated and also determinants of each other, they should not be ignored during the planning of assessment and treatment programs.



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