



Translation, reliability and validity of the Turkish version of Scoliosis Japanese Questionnaire-27 in adolescent idiopathic scoliosis

Tuğba Kuru Çolak¹ · Adnan Apti² · İlker Çolak³ · Burçin Akçay⁴ · Elif Elçin Dereli⁵

Received: 28 February 2023 / Accepted: 29 April 2023
© The Author(s), under exclusive licence to Scoliosis Research Society 2023

Abstract

Purpose Disease-specific scales which evaluate QoL are needed to evaluate treatment outcomes, and to compare the effects of different treatments. The outcome measures evaluating quality of life in adolescent idiopathic scoliosis are limited. The purpose of this study was to examine the validity and reliability of the Turkish version of the Scoliosis Japanese Questionnaire-27 (SJ-27) in adolescent idiopathic scoliosis.

Methods The SJ-27 questionnaire was translated into Turkish and 61 female patients filled out the translated version (TRv. SJ-27) twice to measure the test–retest reliability of the scale. Internal reliability of the questionnaire was estimated using Cronbach’s α coefficient. The intraclass correlation coefficient was analysed for each item. Discriminant validity and convergent validity were determined by correlations with Cobb angle, ATR and the SRS-22r scale.

Results The mean Cobb angle was 25.8° and the ATR angle was 8.8°. Cronbach’s α value was estimated as 0.935. The test–retest correlation coefficient for the item-total score was 0.877 ($p=0.000$). Validity analysis showed a significantly positive correlation between the TRv.SJ-27 total score and Cobb and ATR angles, and a significantly negative relationship was found between the TRv.SJ-27 and SRS-22r scores.

Conclusions It would be useful to use different outcome measures to assess the scoliosis-specific quality of life in clinical practice and research. The findings suggest that the Turkish version of Scoliosis Japanese Questionnaire-27 is a valid and reliable measure to assess Turkish patients with AIS.

Keywords Spine · Scoliosis · Quality of life · Reliability

The study was performed in the Kartal Dr Lütfi Kırdar Education and Research Hospital, Department of Orthopaedics and Traumatology, Istanbul.

The abstract of the study was presented as oral presentation in the 100th Anniversary of Schroth Treatment E-Conference.

✉ Tuğba Kuru Çolak
cktugba@gmail.com

¹ Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Marmara University, Başbüyük Mahallesi, Başbüyük Cd. No: 9, Maltepe, 34854 Istanbul, Turkey

² Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, İstanbul Kültür University, Istanbul, Turkey

³ VM Medical Park Maltepe, Istanbul, Turkey

Introduction

Untreated adolescent idiopathic scoliosis (AIS) has a progression risk. Current treatment approaches of AIS include physiotherapy, scoliosis-specific exercises, brace and surgical treatment [1, 2]. The patients are generally in fairly good health before the diagnosis and usually children and

⁴ Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Bandırma Onyedi Eylül University, Bandırma, Turkey

⁵ Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, İstanbul Bilgi University, Istanbul, Turkey

their parents are not aware of the progression risk of the condition and long-term treatment approaches [3].

Children's exercise and brace compliance is necessary to be able to obtain successful treatment results [4, 5]. Prolonged exercise therapies, brace use for most of the day and while at school, surgical treatment, body image and aesthetic anxiety may increase the stress of children who are already stressed, because they are in adolescence and all these factors significantly affect patients' Quality of Life (QoL) [3, 6, 7].

The "quality of life" is defined by the WHO as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" [8]. The International Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT) professionals has reported that QoL assessment of patients with scoliosis to be of primary and high importance but almost neglected [9]. Generally, in clinical practice, reducing curvature, stopping progression and achieving aesthetic improvement are the primary objectives. However, as stated by Stagnara, we have to treat human beings, not X-rays [9, 10].

It is important that children are asked their thoughts when modifying treatment approaches to be able to increase their treatment compliance and QoL. Disease-specific scales which evaluate QoL are needed for short- and long-term follow-up, to evaluate treatment outcomes, and to compare the effects of different treatments. The outcome measures evaluating quality of life in adolescent idiopathic scoliosis are limited. The Scoliosis Research Society instrument (SRS-24) for evaluation of surgical outcomes was the first disease-specific QoL scale developed by Haher et al. [11], and with further use, it was improved and SRS-23 and SRS-22, SRS-22r and SRS-30 (includes post-surgical assessment) versions were developed [12].

In the literature, it was showed that the Turkish version of SRS-22 is valid and reliable [13]. However, in clinical practice, children with AIS find some questions difficult to understand. Due to cultural differences, Doi et al. developed a questionnaire including 27 items assessing the psychosocial problems experienced by young patients with AIS in daily life, the Scoliosis Japanese Questionnaire-27 (SJ-27) and showed that it is valid and reliable [14].

Different outcome measures are needed for research studies and for the clinical evaluation of the patients. In addition, the existence of different specific scales for QoL is an element that will further enrich and strengthen the clinical evaluation, comparison and decision making. Therefore, the purpose of this study was to investigate the validity and reliability of the Turkish version of the Scoliosis Japanese Questionnaire-27 in adolescent idiopathic scoliosis.

Materials and methods

The study comprised the adolescents with idiopathic scoliosis, who visited our department between September 2019 and March 2020. The study procedure was approved by the IRB and was conducted in compliance with the Helsinki Declaration. Patients and parents were informed about the study and a parent of each child signed an informed consent form. Patients had non-idiopathic scoliosis, any neurological, rheumatological or orthopaedic disease, or spinal surgery were excluded.

The Cobb angle was measured on the final anteroposterior radiograph of the patient. The angle of trunk rotation (ATR) was evaluated in standing forward bending position with a Bunnel Scoliometer®. Maximum ATR value was recorded.

The SJ-27 was developed by Doi et al. [14], as a self-administered, disease-specific, novel quality of life questionnaire consisting of 27 items. Ratings are made on a five-point scale from 0 = no impairment to 4 = severe impairment and then added to get the total score (0–108 points). Questions 1 to 4 assess back pain while lying down and after sitting or standing, or neck/shoulder stiffness or soreness, questions 5–10 and 27 assess discomfort, while wearing clothes or holding bags, questions 11, 15, 16 and 19 assess difficulties associated with participating in physical activities, questions 12 to 14, 22 and 25 assess being self-conscious about appearance and questions 17, 18, 20, 21, 23 assess feelings of anxiety or depression due to the spinal deformity. The authors reported that the SJ-27 showed good reliability and validity for Japanese female patients with AIS.

In the translation process, linguistic validation recommendations of the Mapi Research Institute were followed together with the other validation and reliability studies in the literature. In the first step, permission was obtained from Doi et al. In the second step, an orthopaedic surgeon and a physiotherapist with a good level of English independently implemented the forward translation. Then, the two translations were reviewed by the authors and a joint text was obtained. In the third step, the joint text translated back into English by a physiotherapist, who educated in an English speaking country and a researcher with an advanced level of English. In the final stage, the original and translated English versions were compared by the three researchers and the final Turkish version of SJ-27 (TRv.SJ-27) was obtained. The final sample was administered to 15 healthy adolescents and 15 adolescents with scoliosis to test its comprehensibility. Necessary changes were made if the adolescents had suggestions. To evaluate the test-retest reliability, the questionnaire was reapplied in a 1 or 2-week interval (Table 1).

Haher et al. and the Scoliosis Research Society (SRS) working group developed the SRS-22, which was then

Table 1 Turkish version of Scoliosis Japan Questionnaire-27

Japon Skolyoz Anketi- 27 Türkçe versiyonu

1. Yatarken sırtınızda ve belinizde ne kadar ağrı hissedersiniz?
Hiç Hafif Orta Fazla Şiddetli
2. Bir saat oturduktan sonra sırtınızda ve belinizde ne kadar ağrı hissedersiniz?
Hiç Hafif Orta Fazla Şiddetli
3. Uzun süre ayakta kaldıktan sonra sırtınızda ve belinizde ne kadar ağrı hissedersiniz?
Hiç Hafif Orta Fazla Şiddetli
4. Omuzlarınızda ya da boynunuzda ne kadar sertlik ya da ağrı hissedersiniz?
Hiç Hafif Orta Fazla Şiddetli
5. Mont ya da palto giyerken kendinizi ne kadar rahatsız hissedersiniz?
Hiç Hafif Orta Fazla Oldukça Fazla
6. Kıyafetlerinizin bel seviyesinin eşit durmaması ile ilgili ne kadar endişelenirsiniz?
Hiç Hafif Orta Fazla Oldukça Fazla
7. Kısa ya da kilotlu çorap giymek için öne eğildiğinizde ne kadar zorlanırsınız?
Hiç Hafif Orta Fazla Oldukça Fazla
8. T-shirt giydiğinizde üstünüzde düzgün durmayacağı ile ilgili ne kadar endişelenirsiniz?
Hiç Hafif Orta Fazla Oldukça Fazla
9. Sütyen ya da atlet askılarınızın omuzunuzdan aşağı kayması ile ilgili ne kadar rahatsız olursunuz?
Hiç Hafif Orta Fazla Oldukça Fazla
10. Sıcak havalarda daha ince kıyafetler giyerken sırtınızdaki eğrilikle ilgili kendinizi ne kadar rahatsız hissedersiniz?
Hiç Hafif Orta Fazla Oldukça Fazla
11. Egzersiz yapmaktan kaçınır mısınız?
Asla Nadiren Bazen Sıklıkla Oldukça sık
12. Ebeveynleriniz, arkadaşlarınız ya da öğretmenleriniz size sırt probleminiz olduğunu söylediler mi?
Asla Nadiren Bazen Sıklıkla Oldukça sık
13. Sırtınızdaki eğrilikten dolayı başkalarının yanında mayo giymek ya da üstünüzü değiştirmekten utanır mısınız?
Asla Nadiren Bazen Sıklıkla Oldukça sık
14. Sınıf arkadaşlarınız ya da meslektaşlarınızın görünüşünüzü fark etmesiyle ilgili rahatsızlık duyar mısınız?
Hiç Hafif Biraz Fazla Oldukça Fazla
15. İnsanların önünde ayakta dururken endişelenir misiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
16. Spor aktivitelerine ya da yarışmalarına katılırken kendinizi ne kadar isteksiz hissedersiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
17. Aynadaki görüntünüz sizi ne kadar rahatsız eder?
Hiç Hafif Biraz Fazla Oldukça Fazla
18. Sırtınızın röntgen görüntüleri ile ilgili ne kadar rahatsızlık duyarsınız?
Hiç Hafif Biraz Fazla Oldukça Fazla
19. Spor yada egzersizin omurganızı negatif etkileyeceğini düşünür müsünüz?
Hiç Hafif Biraz Fazla Oldukça Fazla
20. Gelecekte evlilik, doğum yapmak ve durumunuzun çocuklarınıza geçeceği ile ilgili endişelenir misiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
21. Omurganızın şimdiki durumunu değiştirebilmeyi ne kadar istersiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
22. Omurganızın şeklinden dolayı ne kadar utangaç ya da çekingen hissedersiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
23. Omurganızın durumu dolayısıyla kendinizi ne kadar kederli hissedersiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
24. Omurganızın şeklinden dolayı kendinizi diğer kişilerden daha değersiz hisseder misiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
25. Omurganızın şekline bağlı olarak görünüşünüzden dolayı kendinizi aşırı rahatsız hisseder misiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla
26. Omurganızdan dolayı diğer insanlardan daha az yetenekli olduğunuzu düşür müsünüz?
Hiç Hafif Biraz Fazla Oldukça Fazla
27. Çantayı nasıl taşıdığınızla ilgili kendinizi ne kadar rahatsız hissedersiniz?
Hiç Hafif Biraz Fazla Oldukça Fazla

Table 1 (continued)

Lütfen sırtınız ve beliniz ile ilgili aşağıdaki soruları geçtiğimiz ayı düşünerek cevaplayınız. Her bir soru için en uygun cevabı seçiniz. Eğer korse kullanıyorsanız, korse giymediğiniz zamanları düşünerek soruları cevaplayınız

revised and labelled as SRS-22r. The SRS-22r questionnaire has been found to be a valid and reliable method of assessing the quality of life of patients with scoliosis. It includes 22 questions related to function/activity, pain, self-perceived image, mental health, and treatment satisfaction. The first four subgroups contain five questions, and treatment satisfaction two questions. Each item is scored from 1 point (worst possible) to 5 (best possible), giving total scores for the first four subgroups ranging from 5 to 25, and satisfaction from 2 to 10 [11–13, 15].

Cronbach's α coefficient was used to assess the internal reliability of the questionnaire. The Intraclass Correlation Coefficient (ICC) was calculated for each item of the questionnaire. The discriminant validity of the TRv.SJ-27 was determined by analysing the correlation coefficient (Spearman test) between the maximum Cobb and the ATR angle and the total score of the TRv.SJ-27. The convergent validity was analysed with the correlation coefficient (Spearman test) between the TRv.SJ-27 and the SRS-22r scales.

Results

A total of 61 female patients with AIS were included in the study. Thirteen patients were older than 18 years were continuing exercise. These patients were diagnosed with AIS between the ages of 10 and 18 years and presented at our department for treatment during the study period.

The mean age was 15.6 years, the mean Cobb angle was 25.8° and the ATR angle was 8.8° (Table 2). A total of 47 (77%) patients were receiving scoliosis-specific physiotherapy exercises and 14 were receiving scoliosis-specific physiotherapy exercises and wearing a *Chêneau type brace*.

Cronbach's α calculated for internal reliability was 0.935. The correlation coefficients of the items to evaluate the test–retest reliability of the TRv.SJ-27 ranged from 0.628 ($p=0.000$) (question 17) to 0.951 ($p=0.000$) (question 9). The test–retest correlation coefficient for the item-total score was 0.877 ($p=0.000$).

The percentages of patients with a minimum (floor effect) and maximum (ceiling effect) score for each item are shown in Table 2. The total score for the TRv.SJ-27 was 23.5 ± 13.2 (range 2–59) in the first assessment (Table 3).

Validity analysis showed a significantly positive correlation between the TRv.SJ-27 total score and Cobb and ATR angles, and a significantly negative correlation between the TRv.SJ-27 total score and total and subgroup scores of the SRS-22r scale (Table 4).

Table 2 Demographic characteristics and TRv.SJ-27 and SRS-22r scores of patients

Variables	Mean \pm SD (min–max) $n=50$
Age (years)	15.6 \pm 3.2 (10–24)
BMI (kg/m ²)	20.5 \pm 4 (13.8–33.4)
Cobb angle (°)	25.8 \pm 10.7 (10–60)
ATR angle (°)	8.8 \pm 5.7 (1–23)
First Tv. SJ-27 score	23.5 \pm 13.2 (2–59)
Second Tv. SJ-27 score	22.2 \pm 12.4 (2–50)
SRS-22 total score	4.1 \pm 0.3 (3.4–5)
SRS-22 function score	4.6 \pm 0.3 (3.4–5)
SRS-22 pain score	4.1 \pm 0.5 (3–5)
SRS-22 self-image score	3.8 \pm 0.6 (2.8–5)
SRS-22 mental score	3.9 \pm 0.5 (2.6–5)
SRS-22 satisfaction	4.4 \pm 0.6 (2.5–5)

SD standard deviation, *min* minimum, *max* maximum, *BMI* body mass index, *TRv.SJ-27 score* Turkish version of the scoliosis Japan questionnaire, *SRS* scoliosis research society

There was no correlation between BMI and TRv.SJ-27 total score. A significantly positive correlation was found between age and TRv.SJ-27 total score ($p=0.000$, $r=0.593$). There was a significantly difference total TRv.SJ-27 scores ($p=0.003$), when the participants divided in two groups in terms of their age (aged ≥ 19 years and $18 \leq$ years). Older patients had lower TRv.SJ-27 scores (34.1 ± 13.4 , range 12–59), and younger patients had better scores (20.6 ± 11.6 , range 2–48).

Discussion

The Scoliosis Japanese Questionnaire-27 was adapted Turkish language and the validity and reliability for Turkish patients were examined in this study. The findings showed that the Turkish version of the Scoliosis Japanese Questionnaire-27 is an applicable instrument for Turkish patients with AIS.

Recent studies have shown that health-related quality of life is affected in patients with AIS, especially those with a larger curvature, whether treated or not, not only in the treatment process, but also in adulthood [16, 17, 18].

Health-related quality of life assessment is of great importance with patients AIS [9]. Patient-reported disease-specific measures can be used to determine the quality of life of patients, and the SRS-22r scale is generally used to assess health-related quality of life in patients with AIS. A

Table 3 Floor and ceiling effects and ICC for each item of the TRv. SJ-27

Items	% patients with a minimum score	% patients with a maximum score	ICC
Item 1	45.9	1.6	0.888
Item 2	23	1.6	0.739
Item 3	21.3	8.2	0.814
Item 4	47.5	9.8	0.817
Item 5	80.3	0	0.833
Item 6	55.7	1.6	0.714
Item 7	80.3	0	0.900
Item 8	67.2	0	0.729
Item 9	59	4.9	0.951
Item 10	60.7	0	0.747
Item 11	29.5	9.8	0.714
Item 12	49.2	1.6	0.723
Item 13	82	0	0.781
Item 14	57.4	0	0.700
Item 15	78.7	0	0.761
Item 16	57.4	3.3	0.659
Item 17	45.9	0	0.628
Item 18	27.9	4.9	0.752
Item 19	67.2	0	0.855
Item 20	41	3.3	0.781
Item 21	9.8	42.6	0.917
Item 22	55.7	0	0.747
Item 23	29.5	3.3	0.679
Item 24	52.5	0	0.827
Item 25	57.4	1.6	0.697
Item 26	75.4	1.6	0.716
Item 27	59	1.6	0.650
Total score	3.3	1.6	0.877

TRv.SJ-27 score Turkish version of the Scoliosis Japan Questionnaire, ICC Interclass correlation coefficient

Table 4 Correlation analysis between TRv.SJ-27 Total score, Cobb and ATR angles, and SRS-22r scale

Variables	TRv.SJ-27 total score
Cobb angle°	$r=0.255, p=0.047$
ATR angle°	$r=0.444, p=0.000$
SRS-function	$r=-0.507, p=0.000$
SRS-pain	$r=-0.516, p=0.000$
SRS-self-image	$r=-0.339, p=0.007$
SRS-mental	$r=-0.511, p=0.000$
SRS-satisfaction	$r=-0.315, p=0.013$
SRS total	$r=-0.598, p=0.000$

TRv.SJ-27 score Turkish version of the Scoliosis Japan Questionnaire, SRS scoliosis research society

previous study has shown that the Turkish version of the SRS-22 scale is reliable and valid [13]. However, two questions (questions 15 and 18) have been reported to have low internal consistency. In clinical assessment practice, we have observed that children found some questions difficult to understand. The questions “What is your current level of work/school activity? (Şu anda iş ya da okulda ne kadar hareket edebildiğinizi düşünüyorsunuz?)”, “pain medication use (Aşağıdakilerden hangisi beliniz veya sırtınız için kullandığınız ilaçları en iyi şekilde tarif eder?)”, “taken any days off school (Son 3 ay içinde işten ya da okuldan hiç sırt/bel ağrısı nedeniyle izin aldınız mı?) and “whether you find yourself attractive (Beliniz veya sırtınızın şu anki haliyle kendinizi çekici buluyor musunuz?)” are not clearly understood by children. Cultural differences and the age of adolescents may also be reasons for difficulties in understanding these questions. Similarly, Doi et al. reported that some questions of SRS-22r were not suitable for Japanese culture. Therefore, it can be considered that it would be useful in clinical practice and research to use different outcome measures to evaluate quality of life.

To ensure the comprehension of the patients in this study, the expression “when you bend forward” was added to the 7th question in the Turkish version of the scale, because otherwise, in the original form of the question, the children could not understand why they might have trouble putting socks on.

To ensure the cultural adaptation of the 13th question, the question was changed to “Sırtınızdaki eğrilikten dolayı başkalarının yanında mayo giymek ya da üstünüzü değiştirmekten utanır mısınız? (Do you feel embarrassed when wearing a swimsuit or changing your clothes in front of others because of the curve of your back?).

Cronbach’s α was calculated as 0.935. The internal consistency of the Turkish version of the scale showed good reliability and the test–retest results showed good reliability (0.877). In a previous study, similarly higher Cronbach’s α value of 0.914 was reported for the Japanese version of SJ-27 [14].

The total TRv.SJ-27 total score was seen to have a significant positive correlation with the Cobb and ATR angles, and a significant negative correlation was determined between the TRv.SJ-27 total scores and total and subgroup scores of the SRS-22r scale. The reason for the negative correlation is that high scores on the SJ-27 scale indicate severe impairment, whereas low scores on the SRS-22r scale show severe impairment. Doi et al. also reported that the Japanese version of the scale showed a significant correlation with the SRS-22r scale [14].

The frequency distribution of the various questions comprising the instrument were analyzed to determine the floor and ceiling effects. A ceiling or floor effect is usually defined as 15% (or more) of individuals in a sample

achieving the best or the worst level of the score. Floor and ceiling effects for the total SJ-27 were notably low (3.3 and 2%). This result was similar to the results of a study by Doi et al. [14].

In the results of the current study, the total scores of TRv. SJ-27 showed a significantly moderate positive correlation with ATR angle magnitude, and weak positive correlation with Cobb angle magnitude. This may be related to the fact that the angle of rotation angle plays an important role in the cosmetic deformity. Since the correlation of SJ-27 with Cobb angle or ATR angle was not examined in any previous study, it was not possible to compare this result.

A positive correlation was found between the age and total TRv. SJ-27 score in this study and older patients had significantly lower TRv. SJ-27 scores. Similar to these results, Lee et al. reported lower health-related quality of life scores in patients diagnosed with AIS at an older age [19]. Freidel et al. stated that patients aged > 21 years with idiopathic scoliosis had a poorer HRQL than patients aged between 17 and 21 years, and both groups, had a poorer HRQL than the general population [20]. This may also be associated with decreased spinal flexibility and that psychological distress increases with age in adolescence.

A limitation of this study could be considered to be a lack of stratification by curve patterns in the determination of different scores. In addition, different treatment methods (observation, exercise, brace, and surgery) can have different effects on the quality of life of patients. In this study, 84% of the patients were receiving scoliosis-specific physiotherapy exercises, so the internal consistency of the scale could not be compared between untreated patients and those receiving different treatment methods. Future studies should investigate the TRv. SJ-27 results for different treatment methods, age groups, and Cobb magnitude.

The results of this study showed that the internal consistency of a patient-reported outcome measure Turkish version of the Scoliosis Japan Questionnaire showed good reliability and the test–retest results showed good reliability, suggesting that it is an appropriate health-related quality of life assessment instrument for Turkish female patients with adolescent idiopathic scoliosis. It should also be noted that the existence of such an effective quality of life scale alternative will enrich our perspective by providing us with more effective insight in clinical practice and outcome analysis.

Funding There is no financial support granted for this study. The manuscript submitted does not contain information about medical device(s). We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on me or on any organization with which we are associated.

Availability of data and materials The data that support the findings of this study are available upon request from the authors.

Declarations

Conflict of interest The authors declare no conflict of interest.

Ethical approval The ethics approval for the study was obtained from the Ethics Committee of Marmara University (26.09.2019/93). Language editing of the text was performed by native speaker Caroline J. Walker.

Consent for publication All authors whose names appear on the submission: made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work; drafted the work or revised it critically for important intellectual content; approved the version to be published; and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Agabegi SS, Kazemi N, Sturm PF et al (2015) Natural history of adolescent idiopathic scoliosis in skeletally mature patients. *JAAOS* 23(12):714–723
2. Weiss HR, LehnertSchroth C, Moramarco M (2015) Schroth therapy. Lambert Academic Publishing, Deutschland
3. Aulisa AG, Guzzanti V, Perisano C et al (2010) Determination of quality of life in adolescents with idiopathic scoliosis subjected to conservative treatment. *Scoliosis* 5:21
4. Schreiber S, Parent EC, Hill DL et al (2017) Schroth physiotherapeutic scoliosis-specific exercises for adolescent idiopathic scoliosis: how many patients require treatment to prevent one deterioration? - results from a randomized controlled trial - “SOSORT 2017 Award Winner.” *Scoliosis Spinal Disord* 12:26
5. Rahman T, Bowen JR, Takemitsu M et al (2005) The association between brace compliance and outcome for patients with idiopathic scoliosis. *J Pediatr Orthop* 25(4):420–422
6. Kinel E, Kotwicki T, Podolska A et al (2012) Quality of life and stress level in adolescents with idiopathic scoliosis subjected to conservative treatment. *Stud Health Technol Inform* 176:419–422
7. Gallant JN, Morgan CD, Stoklosa JB et al (2018) Psychosocial difficulties in adolescent idiopathic scoliosis: body image, eating behaviors, and mood disorders. *World Neurosurg* 116:421–432
8. The WHOQOL Group (1995) The world health organization quality of life assessment (WHOQOL): position paper from the world health organization. *Soc Sci Med* 41(10):1403–1409
9. Negrini S, Grivas TB, Kotwicki T et al (2006) Why do we treat adolescent idiopathic scoliosis? What we want to obtain and to avoid for our patients SOSORT 2005 Consensus paper. *Scoliosis* 1:4
10. Stagnara P (1976) Les deformations du rachis. *Encyclopédie médico-chirurgicale*, Paris.
11. Haher TR, Gorup JM, Shin TM et al (1999) Results of the Scoliosis Research Society instrument for evaluation of surgical outcome in adolescent idiopathic scoliosis. A multicenter study of 244 patients. *Spine* 24(14):1435–1440
12. Burton DC, Glattes RC (2007) Measuring outcomes in spinal deformity. *Neurosurg Clin N Am* 18(2):403–405
13. Alanay A, Cil A, Berk H et al (2005) Reliability and validity of adapted Turkish version of scoliosis research society-22 (SRS-22) questionnaire. *Spine (Phila Pa 1976)* 30(21):2464–2468
14. Doi T, Inoue H, Arai Y et al (2018) Reliability and validity of a novel quality of life questionnaire for female patients with adolescent idiopathic scoliosis: Scoliosis Japanese Questionnaire-27:

- a multicenter, cross-sectional study. *BMC Musculoskelet Disord* 19(1):99
15. Asher MA, Lai SM, Glattes RC et al (2006) Refinement of the SRS-22 health-related quality of life questionnaire function domain. *Spine* 31(15):593–597
 16. Diarbakerli E, Grauers A, Danielsson A et al (2018) Health-related quality of life in adulthood in untreated and treated individuals with adolescent or juvenile idiopathic scoliosis. *J Bone Joint Surg Am* 100(10):811–817
 17. Watanabe K, Ohashi M, Hirano T et al (2020) Health-related quality of life in nonoperated patients with adolescent idiopathic scoliosis in the middle years: a mean 25-year follow-up study. *Spine (Phila Pa 1976)* 45(2):E83–E89
 18. Soliman HAG (2018) Health-related quality of life and body image disturbance of adolescents with severe untreated idiopathic early-onset scoliosis in a developing country. *Spine (Phila Pa 1976)* 43(22):1566–1571
 19. Lee H, Choi J, Hwang JH et al (2016) Health-related quality of life of adolescents conservatively treated for idiopathic scoliosis in Korea: a cross-sectional study. *Scoliosis Spinal Disord* 11:11
 20. Freidel K, Petermann F, Reichel D et al (2002) Quality of life in women with idiopathic scoliosis. *Spine (Phila Pa 1976)* 27(4):E87-91

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.