Review article
https://doi.org/10.18019/1028-4427-2024-30-4-608-619

Impact of non-surgical factors on treatment results of patients with idiopathic scoliosis according to SRS-22 data (systematic review)

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Abstract

Introduction Idiopathic scoliosis is characterized by a multicomponent deformity of the axial skeleton, surgical correction of which is advisable to improve the quality of life of patients. The SRS-22 questionnaire is widely used for its evaluation.

The **purpose** of the work was to identify and evaluate, using a systematic review method, non-surgical, socio-economic and other factors not directly related to surgical intervention that influence the results of SRS-22.

Materials and methods The search was performed on the PubMed electronic platform in accordance with the PICOS protocol. Initially, 280 articles were selected for the period of 2003-2023. The authors carried out further selection manually. The review was based on the analysis of 15 articles containing data to determine the influence of various factors on the results of the SRS-22 questionnaire.

Results It was revealed that the results of SRS-22 depend on many factors that are not directly related to either the spinal pathology itself or its surgical treatment. Contemporary studies assessing quality of life in scoliosis emphasize the influence of ethnic and socioeconomic factors on the results of the SRS-22 survey. The results indicate differences in the assessment of the quality of life of patients with comparable pathologies depending on the geographical and social context. The role of three-way interaction between the doctor, parents and paediatric patient when assessing the results of the SRS-22 survey was considered. It was found that SRS-22 scores before and after the initial medical consultation did not have significant differences; and the assessment by parents did not differ from the assessment by the paediatric patient. A relationship was found between the use of "rigid" functional corrective braces and the results of SRS-22 — indicators of satisfaction with treatment, and, accordingly, the overall SRS-22 score in patients who received brace therapy were significantly higher. It was found that physical activity and endurance correlate with the quality of life of patients with idiopathic scoliosis.

Discussion The SRS-22 questionnaire is a key tool for assessing the quality of life of patients with scoliosis, taking into account their age and functional status. Over the years of using SRS questionnaires, various scientists have proposed several modifications to improve accuracy and ease of use, but only SRS-22 has become generally accepted. It is necessary to develop special additional algorithms that allow the results of various versions of SRS questionnaires to be interpreted into a single format for their analysis and comparison.

Conclusion The relationship and influence of the severity and structure of spinal deformity on the standard of living is an extremely heterogeneous and multicomponent issue. SRS-22 results are strongly influenced not only by medical factors, but also by age, ethnic, cultural, social and economic factors. There is a gradual change in SRS-22 scores in the postoperative period over decades since the moment of surgery. Parents are quite accurate in assessing their child's condition when using the SRS-22.

Keywords: scoliosis, quality of life, treatment, surgery, paediatrics, SRS-22; questionnaire

For citation: Molotkov YuV, Evsyukov AV, Ryabykh SO, Savin DM. Impact of non-surgical factors on treatment results of patients with idiopathic scoliosis according to SRS-22 (systematic review). *Genij Ortopedii*. 2024;30(4):608-619. doi: 10.18019/1028-4427-2024-30-4-608-619

INTRODUCTION

Idiopathic scoliosis is a multicomponent three-dimensional deformity of the axial skeleton, which includes, in addition to the deformity of the spinal column, deformities of the ribs, chest and often the shoulder blades and pelvic distortions [1]. One of the most important goals of surgical correction is not the absolute correction of the magnitude of scoliotic deformity according to Cobb but the improvement of the balance of the trunk, the physical health of the patient and, as a result, an improvement in the quality of life. Thus, the goals of the operation, among other things, are an increase in respiratory volume, a decrease in back pain, the prevention of further progression of the deformity, and an increase in the motor activity of patients. One of the expectations of both the patients themselves and their relatives is an improvement in the appearance of the body (in the words of D.K. Tesakov, "... plastic anatomy of the trunk" [2]) by reducing visible deformations, which is also an important position among the indications for surgical treatment. For assessing the functional result, questioning patients is of key importance for determining the severity of the disease and the effectiveness of treatment. The Scoliosis Research Society questionnaire (SRS-22), created in 2003, has been currently the most widely used instrument [3] with high reliability for assessing the quality of life of patients with scoliosis of any etiology, considering age and functional status capabilities. The SRS-22 questionnaire is used to assess pain, emotion, level of daily life, improvement in appearance and patient satisfaction before, after surgery and at follow-up points. There are other methods for assessing treatment outcomes (PedsQL [4], EOSQL-24, SF-36 [5], KIDSCREEN-10 [6], etc.), but their specificity varies greatly depending on the age of the patient, the nosology of the spinal deformity and comorbidity.

This review presents an analysis of current scientific literature containing data on the use of the SRS-22 questionnaire to assess the quality of life and treatment effectiveness in patients with scoliosis in various nosological groups.

The **purpose** of the work was to identify and evaluate, using a systematic review method, non-surgical, socio-economic and other factors not directly related to surgical intervention that have an impact on the results of SRS-22 questionnaire.

MATERIALS AND METHODS

The selection was performed on the PubMed platform in accordance with the PICOS protocol using the logical operators AND or OR for the terms: SRS-22, quality of life, scoliosis, surgery (Table 1).

Table 1

Criteria for inclusion/exclusion and selection of publications in accordance with the principles PICOS [7]

PICOS elements	Inclusion	Exclusion
Participants	Patients with spinal pathology who completed the study using the SRS-22 questionnaire, as well as healthy people who completed the study using the SRS-22 questionnaire	Patients who did not complete the SRS-22 questionnaire
Intervention	Assessment of quality of life with the SRS-22 questionnaire	Unavailable data on quality of life with the SRS-22
Comparison	Studied groups in the selected articles	
Result	Results of the SRS-22 questionnaire, assessment of correlation with non-surgical factors	
Study design	Non-randomized, retrospective, prospective	Randomized
Publication	In Russian, English, full text articles	Any other language; full text unavailable

Initially, 280 articles published between 2003 and 2023 were selected (Fig. 1). Then, based on the titles and abstracts of the articles, further selection was carried out manually by the authors: a neurosurgeon with 20 years of experience, an orthopaedic surgeon with 10 years of experience, and an orthopaedic surgeon with 2 years of experience. All specialists are proficient in medical

English and worked with the original texts of publications without the assistance of translators. First of all, the authors evaluated the publications with detailed statistically processed numerical data on the results of assessing the quality of life using the SRS-22 questionnaires in patients with scoliosis. Publications that examined the correlations of the SRS-22 results with various socio-economic aspects of patients' lives were analyzed. The review included also the articles whose study groups consisted of both adolescents and adult patients.

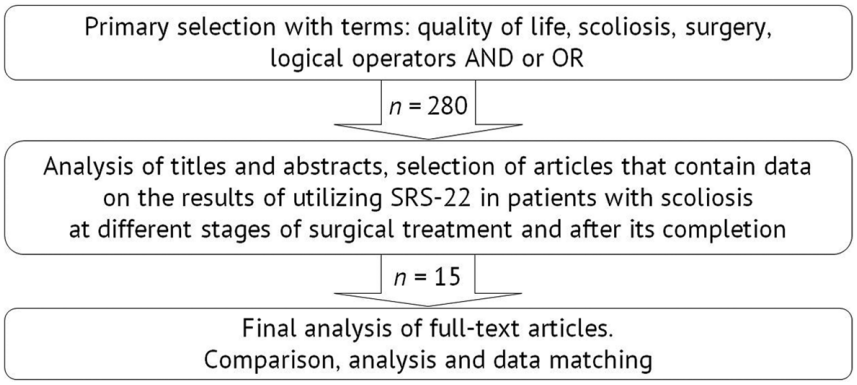

Fig. 1 Diagram of material selection for literature review

As a result, 15 articles were selected containing the necessary data on the use of SRS-22 questionnaires to assess the quality of life in cohorts of patients with scoliosis (Table 2). The data were summarized and analyzed according to the most relevant aspects concerning the validity of the questionnaire and the influence of various factors on it.

Table 2

Summary data on selected literary sources

N	Author, reference list number	Year of publication	Country	Number of patients	Follow-up (years)
1	Yagi et al. [8]	2020	USA+Japan	186	2
2	Ohashi et al. [9]	2020	USA+Japan	405	2
3	Bastrom et al. [10]	2015	USA	829	2
4	Daubs et al. [11]	2014	USA	3052	–
5	Verma et.al. [12]	2014	USA+ Ghana	160	–
6	Alzayed et al. [13]	2022	Saudi Arabia	115	9.4
7	Cheung et al. [14]	2020	China	233	–
8	Chau et al. [15]	2020	China	254	1–2
9	Cong et al. [16]	2021	China	63	–
10	Li et al. [17]	2021	China	259	–
11	Gardner et al. [18]	2021	UK	3481	1
12	Meng et al. [19]	2017	Multinational	640	–
13	Brewer et al. [20]	2014	UK	52	–
14	Yu et al. [21]	2016	China	211	–
15	Gem et al. [22]	2021	Turkey	30	–

RESULTS

Validity of SRS-22 questionnaire in the interaction “doctor-parent-patient”

Considering that scoliotic spinal deformities occur mainly in childhood/adolescence, an important criterion in assessing the patient’s quality of life is the factors of the three-way interaction “doctor – patient’s parent – paediatric patient”.

Brewer et al. studied the influence of these factors on the results of the SRS-22 questionnaire. The SRS-22 questionnaire was distributed to 52 children (13 boys and 39 girls) with adolescent

idiopathic scoliosis and their parents at the first consultation, before and after the meeting with the doctor. Parents and patients filled out the questionnaires separately [20]. No statistical differences were found in the SRS-22 results for both patients and parents when comparing the indicators before and after the consultation in most sections. Significant differences were found in several cases. Thus, there were differences in the patient group before and after the consultation in the "functions" section, the patient and parent groups before and after the consultation in the "pain" section, the patient and parent group after the consultation in the "self-image" section, and the parent group before and after the consultation in the "mental health" section. However, the differences in all these cases were low and were not considered clinically significant.

Based on this, it is noted that the SRS-22 questionnaire reliably reflects the patients' assessment of their symptoms, which is not influenced by the information provided by the doctor during the initial consultation. The parent's assessment of the child's condition using the SRS-22 questionnaire does not statistically differ from the child's self-assessment. The time of filling out the SRS-22 questionnaire during the initial consultation does not have an effect on the overall result of the questionnaire.

The influence of age, ethnicity and socio-economic factors

It was found that the results of the SRS-22 questionnaire are influenced by many factors that are not directly related to either the spinal pathology itself or its treatment. In fact, the initial characteristics of the patient are considered, his/her lifestyle and environment that potentially influence the results of the SRS-22 (Table 3).

Table 3

Results of the SRS-22 questionnaire

Studies			Number of patiens (m/f)	Mean age	Follow-up (years)	SRS-22					
						Function	Pain	Self-image	Mental health	Satisfaction	Score
Yagi et al. [8]	(Japan)		93 (11/82)	65.2	2	3.6	3.8	3.7	3.8	4.0	3.8
	(USA)		93 (10/83)	65.8	2	3.6	3.6	3.7	4	4.3	3.8
Ohashi et al. [9] (USA + Japan)			405	14,4	14.4	–	4.2	3.9	3.3	4	–
Bastrom et al. [10] (USA)			829 (158/671)	–	–	2	4.6	4.4	4.4	4.2	4.6
Daubs et al. [11] (USA)			3052 (1480/1536)	14,6	14.6	–	4.31	4.44	4.41	3.96	–
Verma et.al. [12]	(USA)	healthy	14.8	–	4.4	4.6	4.4	4.1	–	4.4	4.4
		Idiopathic scoliosis	14.8	–	4.2	4.2	3.6	4.1	–	4.1	4.1
	(Ghana)	healthy	14.2	–	4.5	4.3	4.1	3.5	N/A	4.1	4.1
		Idiopathic scoliosis	14.4	–	3.7	3.9	2.9	3.7	N/A	3.6	3.6
Alzayed et al. [13] (Saudi Aravia)			115 (12/103)	24.5	9.4	3.98	4.09	3.98	3.68	4.18	3.98
Cheung et al. [14] (China)			233	–	–	4	4.77	4.72	4.35	3.93	4.45
Chau et al. [15] (China)#			254 (64/190)	15.7	1–2	4.1	4.2	3.9	3.9	4.2	4
Cong et al. [16] (China)			63 (54/9)	14.1	–	2.7	2.32	2.39	2.85	–	2.56
Li et al. [17] (China)			259 (0/259)	14.6	–	4.13	4.38	3.36	4.14	–	4
Gardner et al. [18] (Great |Britain)*			3481	–	1	~4.2	~4.4	~4.2	~4.25	–	~4.25
Meng et al. [19]&			640	–	–	4.3	4.2	3.5	4.8	3.7	4.2
Gem et al. [22] (Turkey)			30	15.8	–	4.5	4.2	4	4	4.7	4.1

— The article by Chau et al. presents data for a period of 1 to 30 years after surgery; this table presents data only 1 year after surgery. More detailed data from this article are presented in the form of a graph further in the text.
* — The article by Gardner et al. presents the data on the SRS-22 results exclusively in the form of graphs, therefore the average values in the table are approximate, for informational purposes only.
& —Meng et al. meta-analysis is a multinational review that compares groups of patients that were brace-treated and not brace-treated before the surgery. Mean data are presented in the table for the total group.

In an analysis of a group of 186 patients, Yagi et al. noted that spinal deformity correction with posterior instrumentation in adults was equally effective for patients in the United States and Japan. However, despite similar deformity correction rates and fusion rates, two-year SRS-22 satisfaction scores were lower in Japanese patients: (4.0 ± 0.8) versus (4.3 ± 0.9) in US patients. Differences in lifestyle and cultural background may have an impact on patient's satisfaction. [8].

In Saudi Arabia, the SRS-22 score in a group of 115 adolescents who underwent surgical treatment for scoliotic deformity was (4.18 ± 1.0). The difference in this indicator may depend on both cultural and sociological characteristics and the age of the patients: in the group from Saudi Arabia, the average age at the time of the survey was 24.5 years versus 65.8 and 65.2 years in the groups from the USA and Japan, respectively [13].

In 2014, Verma et al. conducted a large study comparing the quality of life assessment with the SRS-22 questionnaire in groups of adolescents with scoliosis and their healthy peers from the USA and Ghana [12]. Patients were selected into 4 groups of 40 subjects, in each group the ratio of boys and girls was 15/25. The average age was 14.5 years. The average primary deformity curve according to Cobb in the group of patients from Ghana was higher than in patients from the USA. For all SRS-22 parameters, except for mental health, the group of patients with scoliosis from Ghana showed significantly lower indices than in the other three groups. Patients with scoliosis from Ghana demonstrated significantly lower activity levels than patients with scoliosis from the USA and both groups of healthy adolescents (3.7 vs. 4.2, 4.5, 4.4, respectively). There were no significant differences in activity levels between healthy US adolescents, Ghanaians, and US scoliosis patients. Ghanaian scoliosis patients reported more pain than healthy U.S. individuals (3.9 vs. 4.6), but the difference was less pronounced with healthy Ghanaian adolescents (3.9 vs. 4.3). US scoliosis patients also reported more pain than healthy US adolescents (4.2 vs. 4.6). There were no significant differences in pain scores between healthy Ghanaians and US adolescents (4.3 vs. 4.6), healthy Ghanaians and US scoliosis patients (4.3 vs. 4.6), or Ghanaian scoliosis patients and US patients (3.9 vs. 4.2). Ghanaian scoliosis patients scored significantly lower in the self-image section than US scoliosis patients, healthy Ghanaian and US adolescents (2.9 vs. 4.2, 4.1, 4.5, respectively). Healthy US and Ghanaian adolescents did not differ significantly in the self-image section (4.4 vs. 4.1). Ghanaian scoliosis patients showed significantly lower mental health section scores than US scoliosis patients (3.7 vs. 4.1), but higher than healthy Ghanaian adolescents (3.7 vs. 3.5). It should be noted that the scores of healthy Ghanaian adolescents were significantly lower than healthy US adolescents and even than US scoliosis patients (3.5 vs. 4.1 and 4.1, respectively). The results for healthy US adolescents and US scoliosis patients were similar. Adolescents with scoliosis and without it that lived in Manhattan reported better mental health scores than their Ghanaian peers. Given the significant differences in the standard of living, social and economic well-being, and access to health care between the US and Ghanaian populations, it is clear that all of these factors significantly influence the SRS-22 scores, independent of scoliosis and its treatment.

A group of 233 patients from China, according to the study by Cheung et al. [14], had high scores in the sections of function (4), pain (4.77), self-image (4.72) and mental health (4.35), but had low assessment scores of treatment satisfaction (3.93). The overall SRS-22 score in these patients was also high (4.45).

According to Daubs et al., such factors as age, gender and race have a significant impact on the results of the SRS-22 in healthy adolescents [11]. A large study was conducted among 3,052 healthy volunteers aged 10 to 19 years (Fig. 2, 3, 4).

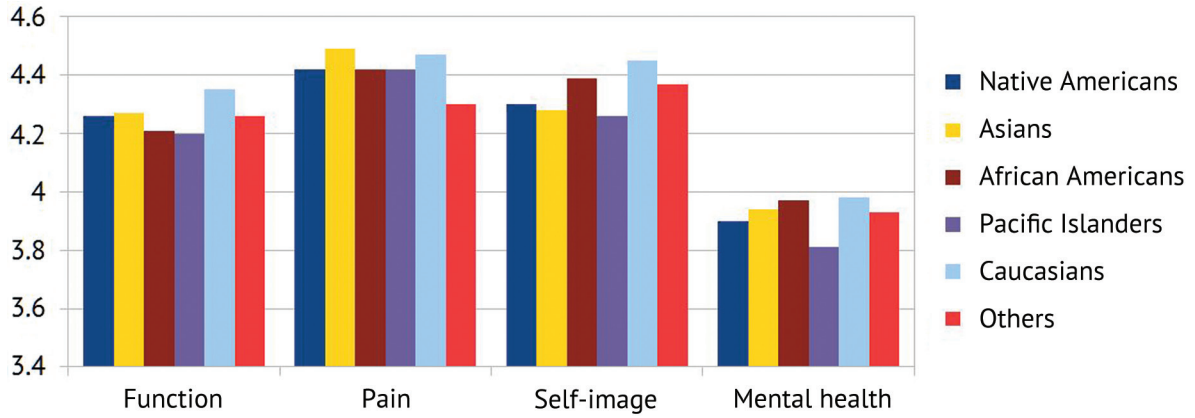

Fig. 2 Distribution of SRS-22 results by nationality [11]

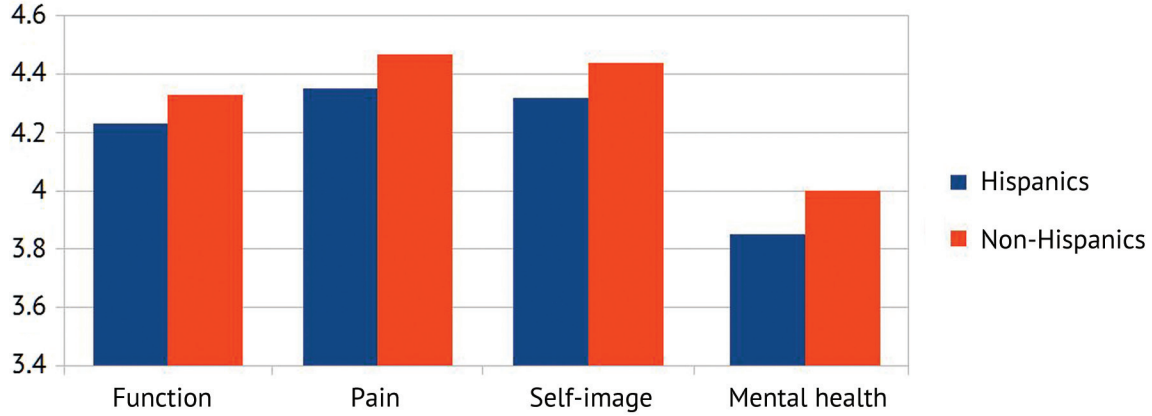

Fig. 3 Distribution of SRS-22 results in Hispanic and Non-Hispanics [11]

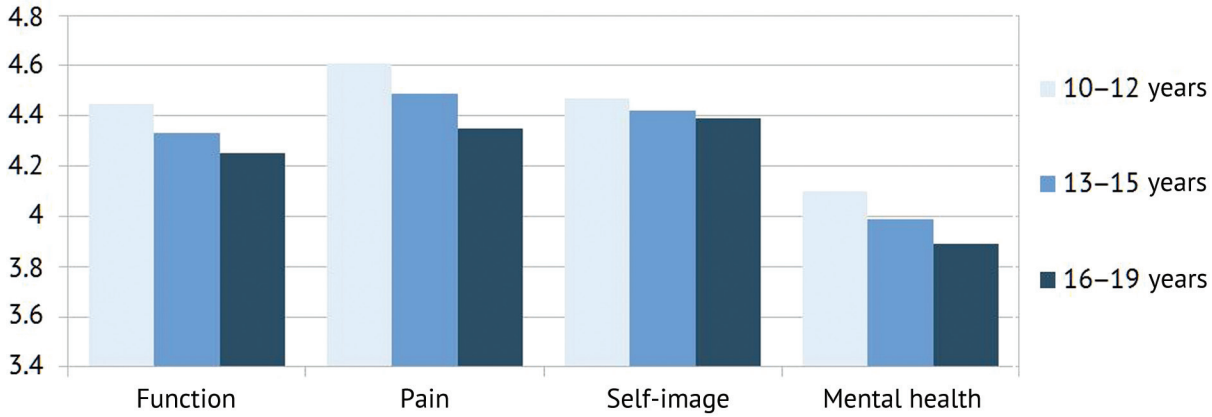

Fig. 4 Distribution of SRS-22 results in regard to age [11]

In general, scores lowered as age increased from 10 to 19 years, Caucasians scored higher in function, pain, and image than other racial groups, and Hispanics scored lower than non-Hispanics in all domains. These factors should be considered when evaluating SRS-22 scores. This suggests that even without any association with spinal pathology and/or its treatment, age and race/ethnicity may influence SRS-22 scores.

Dynamics of indicators at different observation periods

Posterior instrumented spinal fixation surgery is an irreversible intervention that impacts the patient's life once and for all. A study by Gardner et al., conducted in the UK, demonstrated that patient's follow-up data for more than two years after surgery do not differ from the data one year after

surgery [18]. However, Chau et al. [15] conducted a large study that assessed patient's parameters for 30 years after surgery. Long-term follow-up revealed unclear dynamics in postoperative changes in SRS-22. A total of 254 patients were examined, 57 % had surgery 5 years prior to the study, 23 % from 5 to 10 years prior, 13 % from 10 to 20 years prior, and the rest had it more than 20 years ago. Annually, 90 % of patients visited the clinic within 10 years after surgery, 83 % of patients within 10–20 years, and 71 % more than 20 years since surgery. Overall, the scores for the six SRS-22 items were relatively stable from year 5 postoperatively onwards. The Mental Health and Satisfaction sections were significantly better than the Self-image score in the first 5 years postoperatively. Self-image scores were consistently lower than the scores for the other parameters at all time points postoperatively. All scores gradually decreased from year 9 to 30 years and more postoperatively. Pain was also noted to improve after 15–20 years (Fig. 5).

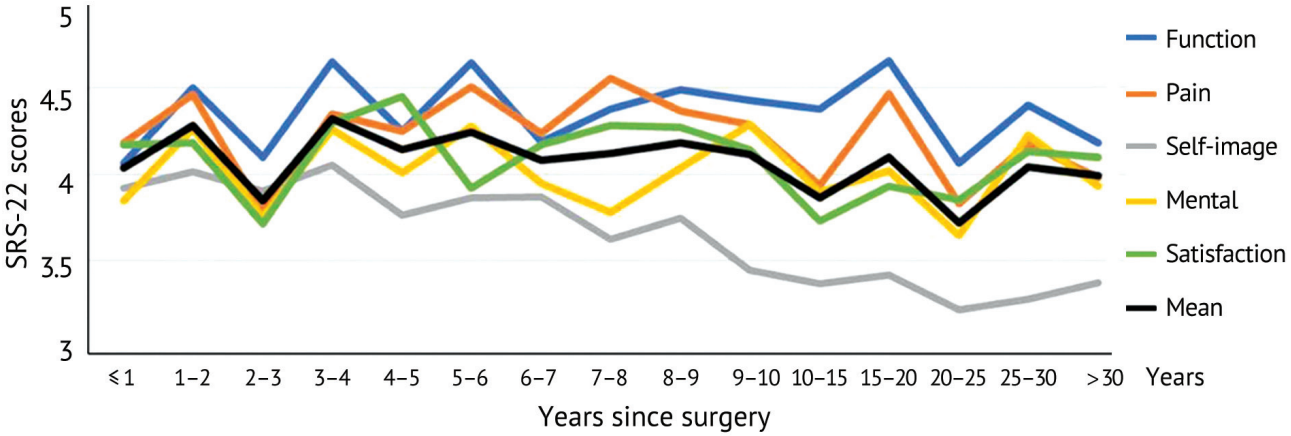

Fig. 5 Distribution of SRS-22 scores in regard to time since the surgery [15]

It is important to note that patients who underwent surgery 30 years ago were in perimenopausal age (> 40 years) at the time of assessment, which might have a significant impact on their mental state and, accordingly, on the SRS-22 results.

Impact of additional methods and treatment option

Apart from surgery, the SRS-22 results are also influenced by other, non-surgical methods used in the treatment of scoliosis. According to Meng et al., there is a relationship between the use of "rigid" functionally corrective braces and the SRS-22 results [19]. A systematic review of the literature was conducted, in which, based on seven publications that passed the inclusion/exclusion criteria, the SRS-22 indicators were determined in the sections of pain, self-imag / appearance, mental health, and function / activity in patients with idiopathic scoliosis. The results in individuals who underwent surgery and did not receive treatment with rigid bracing were similar to the assessments of patients wearing braces. However, the satisfaction rates with treatment, and accordingly the total SRS-22 score in patients receiving brace therapy were significantly higher.

Of interest are the data of the study by Bin et al., which retrospectively analyzed the SRS-22 and SF-36 questionnaires of 211 patients with idiopathic scoliosis who underwent posterior instrumented fixation surgery [21]. The average age of the patients was 14.4 years (range from 11 to 18 years), the patients were divided into 2 groups: with preoperative brace treatment (group BS — 32 cases, 5 men and 27 women) and without preoperative brace treatment (group S — 179 cases, 23 men and 156 women). A comparison of radiographic data and mental health indicators according to the SRS-22 and SF-36 questionnaires was conducted between the patients of the two groups. There were no significant differences between the BS and S groups in the parameters of costal gibbus, mean

preoperative Cobb angle of the primary curve or apical translation of the primary curve, thoracic kyphosis, or coronal trunk balance. The mean mental health scores according to the SRS-22 in the BS and S groups were (3.6 ± 0.7) and (3.7 ± 0.5); the total score was (18.1 ± 3.5) and (18.3 ± 2.6), respectively. The total mental health scores according to the SF-36 of the BS and S groups were (71.1 ± 8.7) and (68.7 ± 11.5), respectively.

Based on these data, it can be concluded that rigid bracing during treatment influences the SRS-22 results only in the issue of satisfaction with treatment.

Another important factor that has an effect on the quality of life is the patient's physical activity. The study by Cong et al. found that physical performance, the ability to exercise intensively and endurance correlate with the quality of life of patients with adolescent idiopathic scoliosis [16]. The study included 54 female patients (mean age 14.1, range 10–19 years) and 9 male patients (mean age 15.9, range 14–19 years) with idiopathic scoliosis (Cobb angle of the primary deformity curve was 28–86°). Significant correlations were found between peak oxygen consumption normalized by body weight and indices of function, pain, mental health and the overall SRS-22 score. Significant correlations were also found between oxygen consumption at the anaerobic threshold normalized by body weight and the indices of function, pain, and total SRS-22 scores. In addition, the respiratory exchange ratio also influenced the total SRS-22 scores.

DISCUSSION

Quality of life is a key issue in medicine and healthcare. Research into the impact of medical care on changes in quality of life includes many scientific projects around the world. According to the PubMed database, more than half a million scientific papers related to HRQoL (Health-Related Quality of Life) have been published over a period of more than 100 years. This is a very large and complex issue, in which there is no unified concept and methodology [23]. Even in such a narrow and "young" issue relative to all of the medicine as the evaluation of the results of surgical treatment of spinal pathology, there is a wide range of concepts and methods for assessing the quality of life of patients.

Over the years of utilizing the SRS questionnaires, several modifications have been proposed by various scientists to improve their accuracy and ease of use. One of the most common options is the SRS-22 and SRS-24 questionnaires (the older version, which was used in many earlier studies). After the shortened modification of the SRS-22 had appeared and become generally accepted, the problem of correlation of the results of these questionnaires arose. In the study by Bastrom et al., 829 patients were surveyed using the SRS-22 and SRS-24 questionnaires [10]. The SRS-22 scores in the pain and general functioning sections were significantly higher than the SRS-24 scores, whereas in the self-image sections, the SRS-22 scores were significantly lower than the SRS-24. The preoperative threshold effect was noted only in one domain. Both versions distinguish between large (> 80°) and small (< 45°) preoperative curves in all sections and total scores. Postoperatively, the SRS-22 scores for all common sections and the total score were significantly higher than the SRS-24 scores. A threshold effect was observed in all five sections postoperatively for the SRS-22 and in 4 of the 7 sections for the SRS-24. At a smaller range of postoperative deformities, only the self-image section of the SRS-22 was able to differentiate between large (> 29°) and small (< 11°) residual deformity curves. In conclusion it was noted that the results obtained with the SRS-22 and SRS-24 are not comparable despite the common sections.

Later, a shortened Rasch-compatible questionnaire SRS-7 was developed based on the SRS-22. According to the study by Caronni et al., the SRS-22 does not meet the fundamental measurement requirements, i.e. additivity, generalizability, and unidimensionality [24]. Moreover, a strong

threshold effect occurs by using the SRS-22 in adolescents with idiopathic scoliosis at their first examination. The SRS-7, a short seven-item questionnaire, provides an HRQL measure that is better adapted to such patients.

In addition, a version of the SRS-18 questionnaire has been proposed, which recommends deleting the most suitable items in each of the four sections of the SRS-22 (items 3, 14, 15, 17), as well as adapting and standardizing other items in different language versions in order to form an improved version of the SRS questionnaire. It is expected that over time, that the SRS-18, if proven to be effective and accurate, would become a common choice for quality of life assessment in patients with idiopathic scoliosis.

In addition to the SRS-22, other questionnaires for assessing the quality of life in patients with spinal pathology have been described in current scientific literature. One of these questionnaires is the EOSQL-24, developed specifically for patients with early scoliosis. Its special feature is that, unlike the SRS-22 questionnaire, the EOSQL-24 is filled out only by the parent or guardian caring for the patient. The study by Li et al. compared these questionnaires [25]. The researchers compared the sections of the questionnaires to identify correlations (Fig. 6).

Fig. 6 Correlation of the corresponding sections of SRS-22 and EOSQ-24 [25]

EOSQ-24	SRS-22
General Health	Function
Pulmonary Function	Function
Transfer	Function
Physical Function	Function
Daily Living	Function
Fatigue	Function
Financial Impact*	Function
Pain	Pain
Emotion	Mental health
Child Satisfaction	Satisfaction
Parent Satisfaction	Satisfaction

*The SRS-22 question that addresses financial impact is in the function domain.
EOSQ-24 indicates 24-item Early-Onset Scoliosis Questionnaire; SRS-22, 22-item Scoliosis Research Society Questionnaire.

A group of 98 patients was examined. The average age at the time of filling in the questionnaires was 9.5 years. Strong correlations were found for all domains except for Satisfaction, when the patient or caregiver filled in both questionnaires. The analysis demonstrated the strongest relationship between domains in the age group from 0 to 5 years. In patients with developmental retardation, weak correlations were noted for all parameters except for pain, which showed a strong correlation. In all subgroups, a strong correlation was observed with pain domains and a weak correlation with satisfaction domains. Based on this study, it was concluded that the SRS-22 may be suitable for children with congenital scoliosis who do not have a diagnosis of developmental retardation. And although the results of the SRS-22 and EOSQL-24 were found to be correlated, it remains unclear which questionnaire is more suitable for patients with developmental delays.

Another popular questionnaire for assessing the quality of life of children and adolescents with various pathologies is the PedSQL-24. However, this questionnaire has not been widely used in patients with scoliosis. The query with key-words PedSQL, scoliosis in the PubMed database found only 13 results,

what excluded a more detailed analysis within the framework of the present review. However, despite the obvious small amount of data, the study of Cheungi et al. found that the total psychosocial health score, the total physical health score, and the total PedsQL score correlated with the total SRS-22r score for all patients with scoliosis [14]. In adolescent patients with scoliosis (13 to 18 years old), both the total PedsQL scores and the total score significantly correlated with each of the SRS-22r domain indicators, with the exception of the "Satisfaction with Treatment" domain.

The current scientific literature contains a fairly large amount of data on the use of SRS questionnaires to assess the quality of life in various groups of patients. Thanks to the ability to compare the results obtained by researchers from different countries, it becomes clear what a pronounced effect on the SRS-22 results ethnic and socioeconomic factors have. In addition to the fact that the indicators change with the patient's age, his ethnic origin, lifestyle and level of financial well-being also have a significant impact on the quality of life. Due to a large number of social, cultural, individual, economic characteristics of life in a particular geographic region and social group, two patients with comparable spinal pathologies and similar surgical treatment outcomes may have significantly different results in assessing the quality of life using the SRS-22 questionnaire. The living environment, rural or urban, may influence the postoperative quality of life in spinal deformities. Self-image indicators are significantly lower in the urban group, but we did not note any other significant differences in activity, pain or mental health indicators compared to the rural group.

The key factor that has an impact on the quality of life of a patient with scoliosis is the extent and structure of spinal deformity. Scoliotic spinal deformity is a clear and severe syndrome that significantly affects almost all aspects of a person's life. Body deformities cause both cosmetic defects and clinical manifestations (pain, fatigue), which, in turn, restrict the patient's physical activity. At the same time, treatment and medical procedures that continue for many years can also affect a person's psychological state, self-perception and quality of life. However, the correlation of SRS-22 results for various indicators with the type, location, severity of the deformity and the extent of its correction was not as obvious and direct as expected.

To what extent do radiographic parameters and their changes during scoliosis treatment may influence the SRS-22 results? The current scientific literature presents rather heterogeneous and contradictory data on this issue. The displacement (translation) of the apical vertebra of the primary curve of deformity has a more significant effect on the patient's self-image than the volume of the primary curve of deformity (Cobb angle) itself [16, 25]. At the same time, the magnitude of the deformity correction resulting from treatment does not directly correlate with the improvement of the SRS-22 indicators after surgical treatment [21]. The structure of the spinal deformity itself is also important, since patients with a triple structural curve have a greater magnitude of deformity and lower scores in the self-image and function sections. All these details indicate that the effect of the volume and structure of scoliotic deformity on the quality of life is a complex multifactorial issue. Posterior instrumental fixation of the spine is a serious surgical intervention that has an impact on the patient's quality of life both immediately after it and decades later. Patients who have undergone such surgery show stable moderately negative dynamics in quality of life indicators [15]. These data are undoubtedly of interest, however, given such a long observation period, it is impossible to say with certainty that the gradual decrease in SRS-22 indicators is associated with surgical treatment.

In addition to the surgical intervention itself, other treatment procedures, such as a course of rigid bracing, may have an impact on the patient's quality of life [18]. However, it is worth noting that such an effect was not that significant and was manifested only in the section of satisfaction

with the treatment. This effect can presumably be explained by the patient's greater personal involvement in the treatment process. Continuous bracing causes some discomfort, inconvenience in everyday life and requires a certain amount of volitional effort. Overcoming these difficulties through personal involvement and by applying patient's own efforts produces a psychological effect that makes him/her more satisfied with the treatment results, despite the fact that from the point of view of radiological indications, such an approach does not have a pronounced positive effect.

Due to the fact that scoliosis usually develops in children/adolescents, it is impossible not to consider the role of parents in the treatment process and their impact on quality of life. It was found that parent's assessment of the child's condition using the SRS-22 questionnaire is not statistically different from the child's self-assessment [19].

CONCLUSION

There are several key points to consider in utilizing the SRS-22 questionnaire in patients with scoliosis:

— The SRS-22 questionnaire is currently the most widely used instrument, as it has high reliability for assessing the quality of life of patients with scoliosis of any etiology, considering age and functional status;

— The relationship and impact of the severity and structure of spinal deformity on the standard of living is an extremely heterogeneous and multi-component issue. The results of the SRS-22 are significantly influenced not only by medical factors, but also by a large number of age-relared, ethnic, cultural, social and economic factors. An attempt to consider the impact of these factors within the framework of the presented questionnaires seems dubious due to their heterogeneity and non-obviousness. This explains the large number of variants and modifications of questionnaires;

— Gradual changes in SRS-22 scores are observed in the postoperative period over decades from the time of surgery. These changes may be caused by factors unrelated to the surgery. Additional medical procedures and conservative treatments, including those associated with other diseases and conditions, may have an impact on patient's quality of life;

— In paediatric patients, the parents assess their child's condition quite accurately with SRS-22;

— Over the many years of using SRS questionnaires, many modifications have been proposed to simplify the work of assessing the quality of life of patients, but none of them, except SRS-22, has become generally accepted. For this reason, it is necessary to develop special additional algorithms that allow interpreting the results of SRS-7, SRS-18, SRS-22, SRS-24, etc. in a single format for their analysis and comparison with each other.

Conflict of interest *Not declared.*

Funding *Not declared.*

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The article was submitted 17.04.2024; approved after reviewing 24.04.2024; accepted for publication 18.06.2024.

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