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Assessment of Construct Validity of the Oswestry Disability Index and the Scoliosis Research Society–30 Questionnaire (SRS-30) in Patients With Degenerative Spinal Disease

Jussi P. Repo, PhD, MD[a], Ville T. Ponkilainen, MD[a,*], Arja H. Häkkinen, PhD[b,c], Jari Ylinen, PhD, MD[b], Paula Bergman, MSc[d], Kati Kyrölä, PhD, MD[a]

[a]*Department of Surgery, Central Finland Central Hospital, Keskussairaalantie 19, 40620 Jyväskylä, Finland*
[b]*Department of Physical Medicine and Rehabilitation, Central Finland Central Hospital, Keskussairaalantie 19, 40620 Jyväskylä, Finland*
[c]*Faculty of Sport and Health Sciences, University of Jyväskylä, Seminaarinkatu 15, 40014 Jyväskylä yliopisto, Finland*
[d]*Department of Public Health, Biostatistics consulting, University of Helsinki and Helsinki University Hospital, Helsinki, Finland*

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Abstract

Study Design: Observational cohort study.
Objectives: To measure and compare the structural validity of the Oswestry Disability Index (ODI) and the Scoliosis Research Society–30 (SRS-30) questionnaire in an adult population with prolonged degenerative thoracolumbar disease.
Summary of Background Data: The ODI and the SRS-30 are commonly used patient-reported outcome instruments to assess back-specific disability and symptoms related to scoliosis. Still, these instruments have not been validated for degenerative spinal disease with different stages of deformity.
Methods: Altogether, 637 consecutive adult patients with degenerative spinal pathologies were included. The patients completed the ODI (version 2.0), the 23 preoperative items of the SRS-30, a general health survey, the Kasari Frequency Intensity Time (FIT) index, the Depression Scale (DEPS), the RAND-36, and visual analog scales for leg and back pain instruments. Psychometric statistical and illustrative analyses were conducted. Deformity groups were analyzed to assess how well the two instruments reflect deformity-related back problems.
Results: Both instruments reflected good coverage and targeting. Correlation between the ODI and the SRS-30 was high ($r = 0.70$; $p < .001$). Both measures could distinguish between different general health states. The SRS-30 strongly reflected mental state and social well-being. The SRS-30 was less sensitive for pain and function. Furthermore, the principal component of pain/function explained more variance in the SRS-30 compared with the ODI score. The ODI was more sensitive for variance of disability among different age and deformity groups.
Conclusions: Both the ODI and the the SRS-30 provide valid scores in evaluating health-related quality of life and/or level of disability among patients with prolonged degenerative thoracolumbar disease. The ODI has slightly higher correlation with physical functioning. The SRS-30 seems to be better when evaluating the emotional and psychological functions.
Level of Evidence: Level III.

Keywords: ODI; SRS; Spine; Validity; Deformity

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IRB approval: This study was approved by the Research Ethics Committee of the Central Finland Health Care District.

*Corresponding author. Department of Surgery, Central Finland Central Hospital, Keskussairaalantie 19, 40620 Jyväskylä, Finland. Tel.: +358142691811.

E-mail address: ponkilainen.ville.t@student.uta.fi (V.T. Ponkilainen).

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Introduction

Low back pain is one of the most frequent causes for musculoskeletal impairment [1-3]. It has been the most common single cause of absence from work in Western countries [1-4]. An effective treatment needs to relieve the socioeconomical burden related to back problems [1,5]. As chronic low back pain is often a complicated combination of physical, psychological, and social aspects, it is essential to have valid tools for the evaluation of the severity of the condition and outcomes after the treatment [6,7].

Adult spinal deformity is composed of multiple changes in the spine [8]. Asymmetrical degeneration can result in scoliotic or kyphotic deformation, and prevalence of spinal deformity increases with age [9,10]. Thus, the evaluation should cover both disability related to back pain but also deformity-related HRQoL.

Evaluation of clinical results with valid instruments help developing the efficacy and quality of the treatment [11,12]. Comparison of scientific evidence to clinical real-life results requires disease-specific patient-reported outcome measures (PROMs) that allows benchmarking [13,14] in addition to clinical, technical, and economical measures. The measurement instrument should be targeted correctly to the measured health issue, and validated properly [15]. Proper validation includes cultural and linguistic adaptation when applicable and a structural validation of the PROMs [14-16].

Oswestry Disability Index (ODI) is a widely applied PROM for back-specific disability [17]. As degenerative spinal conditions also include degenerative deformities, a deformity-specific health-related quality of life (HRQoL) measure has benefits in clinical assessment [9]. The Scoliosis Research Society (SRS) questionnaires were originally developed to measure adolescent scoliosis, but the version with 30 items has been proven appropriate also in measuring the outcome of conservative treatment in adult spinal disease [18,19].

The ODI and the SRS-30 questionnaires are both distinguished tools to evaluate overall back-specific disability and treatment after scoliosis, yet these instruments have not been validated for degenerative spinal disease. Furthermore, the psychometric properties of the ODI and the SRS-30 have not been thoroughly compared head-to-head. Which one of these two appraised tools would be better suitable for patients with degenerative spinal diseases including different grades of deformity? Obtaining additional information about the validity of these two instruments benefit both the clinical and scientific communities as it may help to choose the right assessment tool to assess HRQoL or disability. Although to some extent the Rasch Measurement Theory or the item response theory could serve to compare the construct validity of these two back-specific PROMs, more accurate comparison of the structural validity could be obtained through direct comparison of these PROMs with other outcome measures and their score distribution, linearity, and principal component (PC) analyses.

Our aim was to measure and compare the structural validity of the ODI and the SRS-30 in a consecutive unselected adult population with prolonged degenerative thoracolumbar diseases.

Materials and Methods

The study protocol of the present prospective cohort study was approved by the Ethics Committee of Central Finland Hospital District, Jyväskylä, Finland. A total of 874 consecutive adult patients with prolonged degenerative thoracolumbar disorders were referred from primary health care over the course of one year to the spine clinic of the Central Finland Central Hospital, which serves a population of 275,000. All referred patients were invited to participate in the study. Inclusion criteria were age >18 years, prolonged degenerative thoracolumbar disease with or without radiculating symptoms, and no response to symptoms in primary health care. Exclusion criteria were inability to understand written Finnish language, malignancy, pregnancy, neuromuscular disease, or acute fracture.

Altogether 687 (78.6%) patients volunteered and signed a written informed consent to participate in the study (Table 1). The patients filled in the following questionnaires during their first visit to the spine clinic: the Oswestry Disability Index 2.0 (ODI) [20], the SRS-30 [21-23], a general health data questionnaire, Frequency Intensity Time (FIT) index by Kasari, the DEPS depression test [24], the RAND-36 questionnaire [25], and the visual analog scales (VASs) for leg and back pain [26]. Altogether, 637 (92.3%) patients completed all the questionnaires and were included in the final analysis.

Full spine radiographs were taken, and the spinopelvic parameters of participants were grouped into different deformity grades according to a new simplified classification modified from the SRS-Schwab classification. The simplified classification indicate the following: 0–1 points for none or mild deformity; 2–3 points for moderate deformity; 4–6 points for marked deformity [9].

Instruments

Oswestry disability index 2.0

The ODI is a patient-reported, validated back-specific instrument assessing disability associated with low back pain. It contains 10 items assessing pain severity, self-management, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling. Items are scored from 0 to 5 points (0 = no disability, 5 = worst possible disability). The index is calculated as a percentage of the maximum of at least seven answered items. ODI has been proven to be a good predictor of return to work, isokinetic performance, isometric endurance, and pain with sitting and standing [17].

Table 1
Sociodemographic details and background data.

Participants, N	637
Age, mean (SD)	54.8 (15.3)
Female, n (%)	358 (56.2)
BMI, mean (SD)	27.6 (4.8)
Marriage/common law marriage, n (%)	452 (70.8)
Years of education, mean (SD)	12 (3.6)
Available for work, n (%)	379 (59.4)
Smokers, n (%)	153 (24.0)
Physical activity (Kasari FIT index)	33.5 (21.8)
Daily users of painkillers, n (%)	338 (53.1)
Duration of current back pain in months, median (IQR)	18 (7.60)
ODI, mean (SD)	39 (16)
Back pain, VAS 0–100 mm, mean (SD)	59 (28)
Leg pain, VAS 0–100 mm, mean (SD)	54 (31)
DEPS, mean (SD)	9.2 (6.6)
SRS-30 subscores, mean (SD)	
Function/Activity	2.82 (0.75)
Pain	2.40 (0.76)
Self- Image/Appearance	2.86 (0.67)
Mental Health	3.41 (0.88)
Subtotal score	2.88 (0.61)
Satisfaction with Management	3.12 (0.75)
Total score	2.88 (0.56)
RAND-36 domains, mean (SD)	
Physical functioning	43.9 (24.3)
Role limitations–physical	16.1 (29.0)
Role limitations–emotional	48.4 (43.8)
Energy/fatigue	47.5 (23.3)
Emotional well-being	64.7 (21.9)
Social well-being	57.3 (28.7)
Pain	28.5 (19.7)
General health	46.2 (19.4)

BMI, body mass index; FIT, Frequency Intensity Time; IQR, interquartile range; ODI, Oswestry Disability Index; SD, standard deviation; SRS-30, Scoliosis Research Society–30 questionnaire; VAS, visual analog scale.

Scoliosis research society questionnaire, version 30

The SRS-30 is an HRQoL questionnaire comprising 30 items. Seven of the items (items 24–30) are intended for using after surgery. They were left out of this analysis as majority of the patients had not undergone operation. Each of the 23 general items has five response categories. Items award points between 1 and 5, where higher points indicate a better situation. Item 11 enquires patients' medication use and has a response option "Other" where patients should specify any other medication by written text. Item 23 requests to rate the patient's own self-image on a scale of 1–9, but for the score sheet the answers are divided to five categories in numeric order [22].

The items can be divided into five domains. These domains are Function/Activity, Pain, Self Image/Appearance, Mental Health, and Satisfaction with Management. Mental health items are adopted with permission from the SF-36 instrument [27]. The total score without seven postsurgery questions ranges from 23 to 115 points and for postsurgery patients from 30 to 150 points. A domain cannot be scored if fewer than three questions are answered, except Satisfaction domain, which contains only two questions for nonoperated patients [21,22].

The depression scale

The Depression Scale (DEPS) is a 10-item instrument with four response categories that has been developed to screen depression in primary care units [24,28-30]. Points awarded by the items spread between 0 and 3 points (from best to worst). If the total result is higher than 12 points, the patient has a 50% chance for depression. In cases where the points are higher, the chance for depression is higher [28].

Kasari FIT index

Patients' physical activity levels at leisure time were obtained using the FIT index developed by Kasari [31], which asks about the frequency of exercise per week, the type of activity, and the duration of the exercise. Scores range from 1 to 100 points indicating low (<36), moderate (36–63), or high (>63) physical activity levels.

Statistical methods

Clinical, sociodemographic, and questionnaire data are presented as means with standard deviations (SDs), medians with interquartile ranges (IQRs), 95% confidence intervals (CIs), as counts with percentages, or as ranges. Normality of the data for the two instruments was assessed.

Spearman rank correlation was used to identify the relationship between the ODI and the SRS-30. Bootstrap method with 5,000 replications was used to obtain 95% CIs for correlations. The ordinal correlation was investigated by ranking the patients from the lowest score to the highest score. Thereafter, the rank scores were compared between the two instruments.

Patient-reported general health status was divided into four levels—very good, good, bad, and very bad—and compared with the scores obtained from the back-specific instruments. The scores of the ODI instrument were reversed to be comparable to those of the SRS-30, as lower scores in the ODI refer to lower disability.

Linear regression analyses were used to identify the appropriate predictors of the DEPS, back or lower extremity pain, and RAND-36 dimensions. Age, gender, and deformity grade-standardized regression coefficients (beta β) indicate how strongly each predictor variable influences the criterion (dependent) variable. The β was measured in units of SD.

To conduct a regression analysis, all the items of DEPS, RAND-36, and Kasari instruments were reduced to PCs. A log transformation was applied to the continuous variables [32]. PCs were chosen according to Kaiser criteria, where a component was identified if the eigenvalue was equal to 1 or higher. The PCs were used to calculate how much variance the pain/function-related variables would explain as a whole. Thereafter, a single PC consisting of all the main PCs was produced to exclude multicollinearity bias. Rotation local regression together with the LOESS curve with 95% CIs was used to illustrate the association between the ODI and the SRS-30 instruments.

Results

All 637 patients who participated in the study provided valid questionnaires. The mean ODI score was 39 points (SD, 16) (Fig. 1A). The mean of SRS-30 score was 68.9 (SD, 13.2) (Fig. 1B). Maximum or minimum points were obtained by none of the patients for ODI or for the SRS-30. The distribution of ODI was slightly bimodal, as fewer patients answered around the average score. The distribution of SRS-30 was quite regular.

Correlations

Figure 2 describes the ranking of patient scores for the ODI and the SRS-30. Linearity was found between the ranking of patients when ordered according to the ODI and the SRS-30 score ($p < .001$). The Spearman correlation coefficient between ODI and SRS-30 was 0.70 ($p < .001$). The highest correlations among the scores were with RAND-36 physical functioning ($r = 0.75$ and $r = 0.61$) and social well-being ($r = 0.63$ and $r = 0.71$) (Table 2). Lowest correlations were found with the Kasari index ($r = 0.35$ and $r = 0.32$) and lower extremity pain ($r = -0.39$ and $r = -0.31$). The variation between the back-specific scores was lowest in RAND-36 role limitations/physical dimension (0.47 and 0.47) and Kasari index (0.35 and 0.32). The SRS-30 had notably stronger correlation with RAND-36 emotional well-being ($r = 0.70$ and $r = 0.41$) and energy/fatigue ($r = 0.70$ and $r = 0.49$), and DEPS ($r = 0.76$ and $r = 0.54$), yet the ODI was slightly superior in RAND-36 physical functioning ($r = 0.75$ and $r = 0.61$). All correlations were statistically significant ($p < .001$).

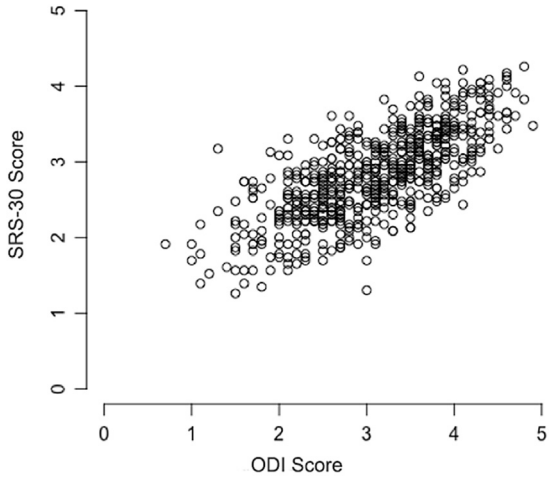

Fig. 2. Linearity between the preoperative section of the Scoliosis Research Society–30 (SRS-30) and the Oswestry Disability Index (ODI) score.

Relationship between back-specific instruments ODI and SRS-30 scores and reference outcome measures was evaluated (Fig. 3). All relationships were statistically significant ($p < .001$).

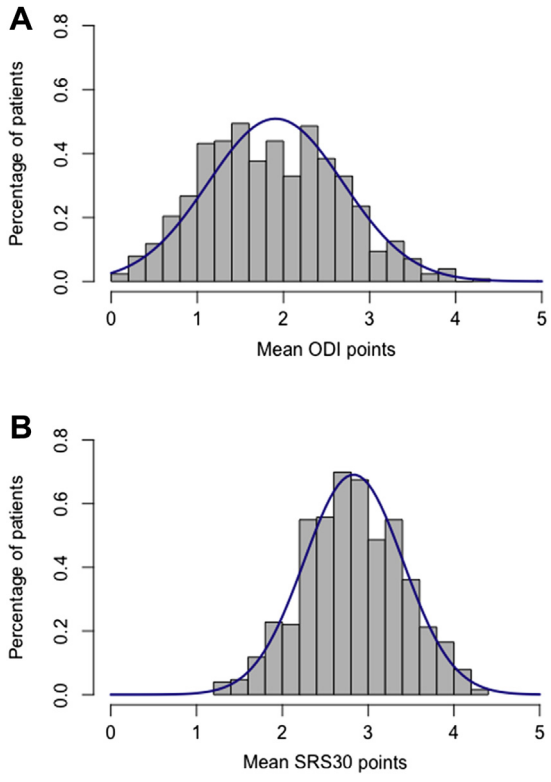

Fig. 1. Distribution of the (A) Oswestry Disability Index (ODI) and the (B) Scoliosis Research Society–30 (SRS-30) scores.

Table 2
Spearman correlation of back-specific instruments of Oswestry Disability Index (ODI) and Scoliosis Research Society–30 (SRS-30) and reference outcome measures.

Variable	ODI, *r* (95% CI)	SRS-30, *r* (95% CI)
RAND-36 domains		
Physical functioning	0.75 (0.72 to 0.80)	0.61 (0.56 to 0.67)
Role limitations–physical	0.47 (0.40 to 0.53)	0.47 (0.40 to 0.53)
Role limitations–emotional	0.37 (0.31 to 0.44)	0.54 (0.47 to 0.59)
Energy/fatigue	0.49 (0.42 to 0.54)	0.70 (0.65 to 074)
Emotional well-being	0.41 (0.35 to 0.47)	0.70 (0.66 to 0.74)
Social well-being	0.63 (0.58 to 0.68)	0.71 (0.67 to 0.76)
Pain	0.66 (0.61 to 0.71)	0.61 (0.56 to 0.67)
Physical activity*	0.35 (0.28 to 0.43)	0.32 (0.25 to 0.40)
DEPS†	0.54 (0.48 to 0.60)	0.76 (0.72 to 0.79)
Back pain (VAS)	−0.47 (−0.40 to −0.54)	−0.42 (−0.35 to −0.48)
Lower extremity pain (VAS)	−0.39 (−0.32 to −0.46)	−0.31 (−0.24 to −0.37)

CI, confidence interval; DEPS, Depression Scale; VAS, visual analog scale.

All correlations were statistically significant, $p < .001$.

* Kasari FIT (Frequency Intensity Time) index.

† The Depression Scale.

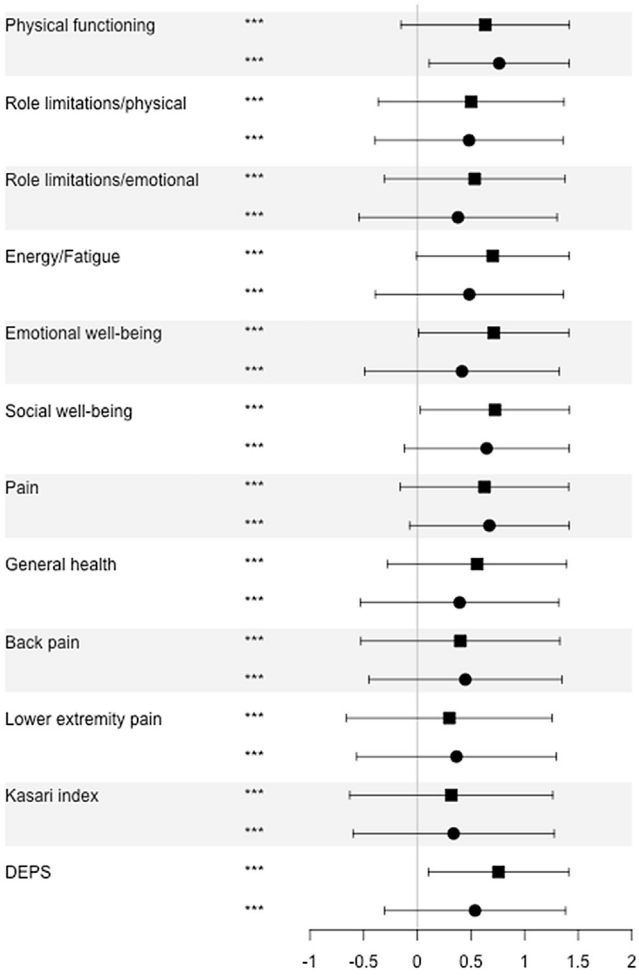

Fig. 3. Relationship between back-specific instruments and reference outcome measures. Cohen standard for β values above 0.10, 0.30, and 0.50 represent small, moderate, and large relationships, respectively. The box represents the SRS-30 score and the circle the ODI score (reversed). Whiskers show the 95% confidence intervals. All relationships were statistically significant ($p < .001$).

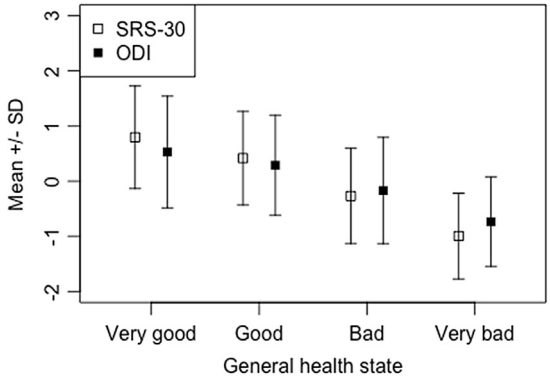

Fig. 4. The Scoliosis Research Society−30 (SRS-30) and the Oswestry Disability Index (ODI) score compared with four states of general health. From left to right, smoothed conditional means with 95% confidence intervals are presented.

The ODI and SRS-30 scores were compared with four states of general health (Fig. 4). The scores showed a slight linear decrease where general health was lower. The results for both instruments were relatively comparable.

Independent relationship of pain and function were investigated against the back-specific instruments with linear regression models (Fig. 5A and B). Each regression model was adjusted with age and gender. Scattering of scores was larger in the SRS-30 than the ODI. The SRS-30 explained less of the PC of pain/function, indicating larger variance. The ODI had larger coverage for pain/function according to the PC analyses.

The mean scores of ODI and SRS-30 instruments were compared in different age groups and deformity stages (Fig. 6). The scores of the SRS-30 were similar among all deformity stages.

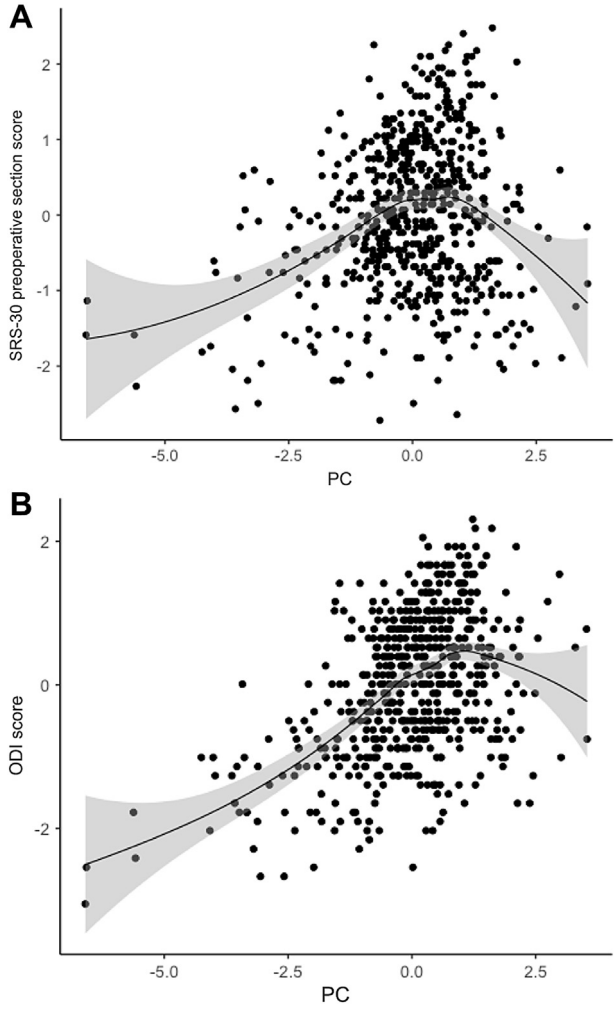

Fig. 5. A and B. Relationship of the back-specific instruments with the principal component (PC): (A) Scoliosis Research Society−30 (SRS-30) score; (B) Oswestry Disability Index (ODI) score. The LOESS curve shows the deterministic part of the variation in the data. Gray area around the curve describes the 95% confidence intervals.

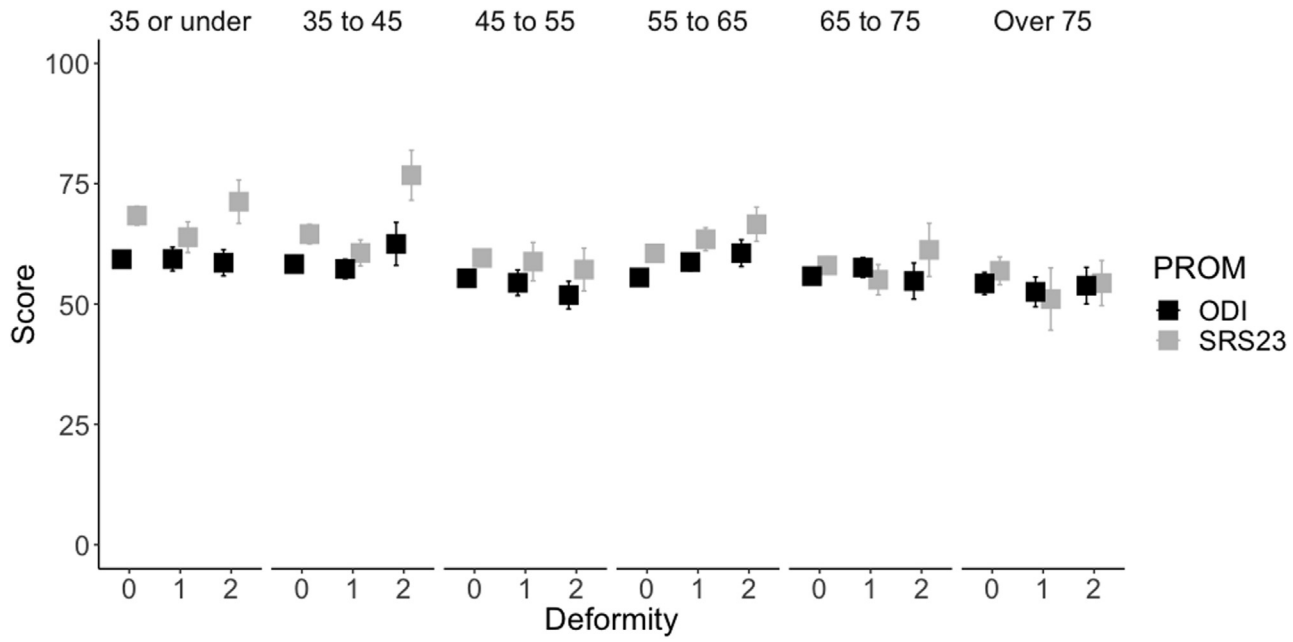

Fig. 6. The differences between the scores of the Scoliosis Research Society–30 (SRS-30) and the Oswestry Disability Index (ODI) score different age and deformity (0 = none or mild deformity; 1 = moderate deformity; 2 = marked deformity) groups.

Discussion

Main findings of the present study were that these two back-specific PROMs provide valid scores in assessing disability and HRQoL among patients with a degenerative spinal disease and different stages of deformity. They correlate well with each other. The ODI represents slightly more of physical functioning, whereas the SRS-30 seems to be better when evaluating the emotional and psychological functions.

Broad variety of back-related issues and high prevalence of nonspecific back pain makes the evaluation of treatment outcomes more complex [1,33]. Pain and physical functioning have the most important role when evaluating the outcomes after treatment of back-related problems [34]. When considering operative treatment, function and clinical symptoms have been the most common factors for patients to seek operative treatment for spinal disease [35]. Reduction of pain is the main element of patient satisfaction during treatment [36]. Nevertheless, psychosocial factors are important to screen as they have a significant role in turning the acute back pain into chronic problem [37]. As the ODI and the SRS-30 had high correlation and low differences in correlations with physical aspects, it indicates that these scores are well-performing PROMs to measure the most crucial aspects of disability. The SRS-30 had a higher correlation with emotional outcomes such as emotional well-being, energy/fatigue and the DEPS (depression) score. Because the SRS-30 has many items concerning psychosocial functions and the ODI focuses purely on the pain-related physical side, the result was to be expected. Our study supports the hypothesis that the SRS-30 is better when evaluating the back-related psychological and social disadvantage, whereas the ODI is slightly better for evaluating the physical performance.

Although it has been recognized that a higher level of physical activity correlates with well-being [38], the physical activity measured with the Kasari FIT index had low correlation with the ODI and the SRS-30 scores in the present study. This may result from the limitations in the Kasari index. The Kasari index measures only the frequency, intensity, and time of physical exercises, yet it neglects the basic activity of everyday life [31]. Therefore, it evaluates only the specific trainings and does not count the overall physical activity of the patient.

Most back pain is considered nonspecific when there is no specific causal relationship between radiographic findings and back pain [33]. In the present study, there was low correlation between the ODI and the SRS-30 scores and lower extremity pain (leg pain VAS scores), which results from the previously stated fact that most of the back-related pain does not have a specific cause such as disc herniation or tumor, which would also cause the radicular pain in the lower limb [33]. Regardless, the relationship between the ODI and the SRS-30 and all reference outcome measures were statistically significant. Further, the patient's ranks between these scales were linear, indicating that these scales are valid instruments to measure disability and HRQoL. The ODI scores were highest in the younger age groups, with marked deformity. A previous study also found excellent construct validity of the ODI, and findings indicated that it has a good ability to discriminate in different states of functional disability [39]. The SRS-30 scores remained similar in all age and deformity groups.

To conclude, both the ODI and the SRS-30 provide valid scores in evaluating HRQoL and level of disability among patients with prolonged degenerative thoracolumbar diseases. The relationships between questionnaires and all reference outcome measures were statistically significant, and the patient's ranks between these scales are linear. The ODI reflects more physical functioning, and the SRS-30 can be considered slightly better when evaluating the emotional and psychological functions.

Key points

- Oswestry Disability Index (ODI) and Scoliosis Research Society version 30 (SRS-30) are commonly used tools to evaluate the outcome of treatment in adult spinal deformities, yet they are not validated among patients with degenerative back-specific problems.
- As a result of this study, both questionnaires are valid instruments among patients with a degenerative spinal disease.
- The ODI has slightly higher correlation with physical functioning, and the SRS-30 is slightly better when evaluating the emotional and psychological functions.

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