

HEALTH SERVICES RESEARCH

Patient Satisfaction After Adult Spinal Deformity Surgery Does Not Strongly Correlate With Health-Related Quality of Life Scores, Radiographic Parameters, or Occurrence of Complications

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Study Design. This is a multicenter retrospective review of prospectively collected cases.

Objective. Our objective was to evaluate the relationship between patient satisfaction, health-related quality of life (HRQoL) scores, complications, and radiographic measures at 2 years postoperative follow-up.

Summary of Background Data. For patients receiving operative management for adult spine deformity (ASD), the relationship between HRQoL measures, radiographic parameters, postoperative complications, and self-reported satisfaction remains unclear.

Methods. Data from 248 patients across 11 centers within the United States who underwent thoracolumbar fusion for ASD and had a minimum of 2 years follow-up was collected. Pre- and postoperative scores were obtained from the Scoliosis Research Society 22-item (SRS-22r), the Oswestry Disability Index (ODI), the 36-Item Short Form Health Survey (SF-36), and the Visual Analogue Scale. Sagittal vertical axis, coronal C7 plumbline, lumbar lordosis, pelvic tilt, T1 pelvic angle, and the difference

between pelvic incidence and lumbar lordosis were assessed using postoperative radiographic films. Satisfaction (SAT) was assessed using the SRS-22r; patients were categorized as highly satisfied (HS) or less satisfied (LS). The correlation between SAT and HRQoL scores, radiographic parameters, and complications was determined.

Results. When compared with LS (n=60) patients, HS (n=188) patients demonstrated greater improvement in final ODI, SF-36 component scores, SRS-Total, and Visual Analogue Scale back scores ($P < 0.05$). The correlations between SAT and the final follow-up and 2 year change from baseline values were moderate for Mental Component Summary, Physical Component Summary, and ODI or weak for HRQoL scores ($P < 0.0001$). The HS and LS groups were equal in pre- or final postoperative radiographic parameters. Occurrence of complications had no effect on satisfaction.

Conclusion. Among operatively treated ASD patients, satisfaction was moderately correlated with some HRQoL measures, and not with radiographic changes or postoperative complications. Other factors, such as patient expectations and relationship with the surgeon, may be stronger drivers of patient satisfaction.

Key words: complications, HRQoL, ODI, satisfaction, scoliosis, SF-36, spine fusion, spine surgery, SRS-22r, VAS.

Level of Evidence: 3

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In recent decades, attempts have been made to better evaluate clinical outcomes of medical care from the patient's perspective.^{1–4} As part of these efforts, patient satisfaction has emerged as a metric for evaluating quality of clinical care.^{5–8}

Physicians' therapeutic decision making for patients with adult spine deformity (ASD) is currently based in large part on radiographic parameters, pain and disability levels,

neurologic impairment, and surgical risk. On the other hand, payers are stratifying hospitals and health care providers using measures such as patient satisfaction scores and complication rates. To date, relatively little data has emerged regarding the drivers of postoperative satisfaction in patients undergoing spinal reconstructive surgery for ASD.^{1,7,9}

Determinants of patient satisfaction in other clinical domains have proven to be complex.^{1,5,8,10} Patient's expectations as well as mental and physical well-being have been shown to influence their reported satisfaction with treatment.¹¹⁻¹³ Other factors previously shown to impact patient satisfaction have included complications, hospital experience, as well as the pre- and postoperative care received.¹⁴⁻¹⁹ Additional studies have found that patient satisfaction can also depend on the type of surgery and the patient's demographic background.²⁰⁻²²

The modified Scoliosis Research Society (SRS-22r) health-related quality of life (HRQoL) questionnaire has been validated and used as a measure of outcomes related to scoliosis and spinal deformity surgery. The SRS-22r questionnaire consists of five domains including function/activity, pain, self-image/appearance, mental health, and satisfaction with management. Previous studies have evaluated the individual domains of the SRS-22r, including the satisfaction score, and validated their use through comparison to other patient-centered assessment tools.^{19,23, 24}

For patients undergoing reconstructive surgery for ASD, no prior evaluation of the correlation between patient satisfaction, HRQoL scores, postoperative radiographic improvements, and occurrence of postoperative complications has been reported. Understanding the drivers of patient satisfaction is important to clinical decision making and optimizing outcomes. This is a retrospective multicenter evaluation of these relationships within a prospectively collected database of ASD patients with minimum 2 year follow-up.

MATERIALS AND METHODS

Patient Inclusion

The International Spine Study Group consisting of 11 sites contributed surgical ASD cases during 2010 and 2011 to a prospective clinical database. Each site's participation followed protocol approval by their local Institutional Review Board.

Patients were considered for inclusion in the study if they had thoracolumbar fusion of five or more spinal levels for management of ASD with at least 2 years follow-up. Minimum patient age was 18 years. Minimal preoperative spinal deformity parameters were Cobb angle $\geq 20^\circ$, sagittal vertical axis ≥ 5 cm, pelvic tilt $\geq 25^\circ$, and/or thoracic kyphosis $\geq 60^\circ$.²⁴ Inclusion criteria were intentionally broad to maximize the external validity of the study's findings. Patients were excluded if their spinal deformity was related to malignancy, active infection, or neuromuscular etiology.

Assessment of Satisfaction

The SRS-22r patient satisfaction score (SAT) is derived from two questions within its survey (Questions 21 and 22). Question 21 asks, "Are you satisfied with the results of your back management?". Question 22 asks, "Would you have the same management again if you had the same condition?". Each is scored from 1 to 5. Both 4 and 5 indicate high levels of satisfaction. The average of the two scores defines SAT. In this study, SAT was used as the global assessment of patient satisfaction. Measurement of SAT took place at 6 weeks, 1 year, and 2 years follow-up. Patients with a score greater than or equal to 4 at 2 years were categorized as being highly satisfied (HS), and those with a score less than 4 were categorized as being less satisfied (LS).

Measurement of Surgical Outcomes

Changes in HRQoL were measured using the Oswestry Disability Index (ODI), the 36-Item Short Form Health Survey (SF-36) Physical Component Summary and Mental Component Summary scores, and the Visual Analogue Scale (VAS) for the back and leg. Postoperative patient radiographs were assessed to measure coronal C7 plumbline, lumbar lordosis, sagittal vertical axis, pelvic tilt, T1 pelvic angle, and the difference between pelvic incidence and lumbar lordosis. Complications within the follow-up period were defined as being either minor or major, using the criteria described by Glassman *et al.*²⁵

Correlation of Satisfaction and Surgical Outcomes

The Spearman rank correlation test was used to identify associations between SAT and 2-year final and change from baseline HRQoL scores, and radiographic parameters. The correlation of major and minor complications to SAT was also measured in the same fashion.

Statistical analysis was performed using the Student *t* test for normally distributed data and Wilcoxon rank-sum test for non-normal data distributions. All statistical analyses were conducted using commercially available software, SAS 9.3 (SAS Foundation, Cary, NC). The level of statistical significance was set at $P < 0.05$.

RESULTS

Drawing from a registry population of 333 patients, 85 (26%) were lost to follow-up. A total of 248 patients with at least 2 years follow-up were therefore included in the study. Within this population, 75.8% ($n = 188$) were HS and 24.2% ($n = 60$) were LS. Overall, SAT scores were high (median 4.5; range 1-5) with a distribution that was negatively skewed.

Significant differences between HS and LS groups were observed in both final follow-up scores and change from baseline scores for all HRQoL outcomes (Table 1), with the exception of change from baseline VAS Leg score. At 2 year follow-up mean ODI, in particular, showed a significant difference between HS (20.4) and LS (41.7) with change from baseline of -19.1 and -2.9 respectively.

TABLE 1. Health-Related Quality of Life Scores in Relation to Level of SRS-22 Satisfaction

	HRQoL Scores at 2-Year Follow-up			HRQoL Scores—Change From Baseline		
	Less Satisfied (N = 60)	Highly Satisfied (N = 188)	P Value	Less Satisfied (N = 60)	Highly Satisfied (N = 188)	P Value
	Mean	Mean		Mean	Mean	
ODI	41.7	20.4	<0.0001	-2.9	-19.1	<0.0001
PCS	33.4	44.3	<0.0001	0.3	10.5	<0.0001
MCS	41.0	53.3	<0.0001	1.1	5.3	0.031
VAS back	5.2	2.8	<0.0001	-1.3	-4.0	<0.001
VAS leg	3.6	2.2	0.003	-0.1	-1.9	0.220
SRS_total	2.9	4.0	<0.0001	0.2	1.1	<0.0001

HRQoL indicates health-related quality of life; MCS, Mental Component Summary; ODI, Oswestry Disability Index; PCS, Physical Component Summary; SRS, Scoliosis Research Society; VAS, Visual Analogue Scale.

Most radiographic measures did not differ statistically between HS and LS groups at final follow-up or in change from baseline scores (Table 2). However, lumbar lordosis and T1 pelvic tilt were significantly higher in the HS group, compared with the LS group ($P = 0.027$ and 0.045 , respectively), at final follow-up, although the change from baseline was equivalent in the two groups.

Moderate correlations ($|r| \geq 0.40$) were found between satisfaction and 2-year final follow-up and change from baseline scores in ODI, Physical Component Summary, and Mental Component Summary scores ($P < 0.0001$). SAT was weakly correlated with VAS Back Pain score ($r = 0.3$, $P < 0.0001$) (Table 3). Of the radiographic parameters, only final pelvic tilt demonstrated a significant, albeit weak, correlation to satisfaction ($r = 0.15$, $P = 0.02$) (Table 4).

There were 171 complications in the 248 patients at 2 years follow-up; 97 (57%) patients had major complications and 74 (43%) had minor complications. Satisfaction was not significantly affected by the presence of major or minor complications (Figure 1). Regardless of the presence of a complication, no patients demonstrated a significant change in SAT from 6 weeks to 2 years ($P < 0.0001$). At all post-operative time points assessed, patients who experienced a

complication demonstrated no significantly different satisfaction than those who did not (Figure 1).

DISCUSSION

In this multicenter study of surgical ASD patients, HS patients demonstrated greater improvement in all HRQoL measures than LS patients. This agrees with recently published single center data.⁷ Interestingly, however, HS patients did not demonstrate significantly better radiographic outcomes than LS patients. This is also consistent with Gum *et al's* report.⁷ The lack of a correlation between radiographic outcomes and satisfaction is particularly interesting given prior reports showing strong correlations between radiographic parameters (especially sagittal balance) and HRQoLs.^{26,27} This may reflect the fact that although differences had the potential to rise to statistical significance, actual correlation coefficients were weak to moderate.

Complications also demonstrated no significant effect on satisfaction. A recent study reported a similar lack of correlation between complications and patient satisfaction.²⁸ Our study provides an opportunity to evaluate a more mature version of the same registry data. While the previous study was able to identify the adverse effect that reoperation

TABLE 2. Radiographic Parameters at 2 Years in Relation to Level of SRS-22 Satisfaction

	Radiographic Parameters at 2-Year Follow-Up			Radiographic Parameters—Change From Baseline		
	Less Satisfied (N = 60)	Highly Satisfied (N = 188)	P Value	Less Satisfied (N = 60)	Highly Satisfied (N = 188)	P Value
	Mean	Mean		Mean	Mean	
Coronal plumbline (mm)	-3.9	0.6	0.47	-2.6	-1.9	0.95
Lumbar lordosis (degrees)	48.1	52.9	0.03	12.2	9.6	0.52
Sagittal vertical axis (mm)	43.5	25.3	0.06	-26.2	-26.7	0.99
Pelvic tilt (degrees)	20.9	20.7	0.94	-2.1	-2.0	0.94
T1 pelvic angle (degrees)	2.8	4.2	0.045	2.2	2.0	0.76
Pelvic incidence/lumbar lordosis mismatch (degrees)	5.2	3.1	0.38	-11.2	-9.4	0.50

TABLE 3. Correlation Coefficient Between SRS-22 Satisfaction and HRQoL Measures at Final Follow-up and Change From Baseline

Correlation Coefficient (<i>r</i>) Between Satisfaction and Final Follow-Up or Change From Baseline				
HRQoL Variable	Final Follow-Up	<i>P</i> Value	Change From Baseline	<i>P</i> Value
ODI	−0.48	<0.0001	−0.36	<0.0001
PCS	0.46	<0.0001	0.47	<0.0001
MCS	0.39	<0.0001	0.53	<0.0001
VAS back pain	0.38	<0.0001	0.30	<0.0001
VAS leg pain	0.18	0.007	0.06	0.362

HRQoL indicates health-related quality of life; MCS, Mental Component Summary; ODI, Oswestry Disability Index; PCS, Physical Component Summary; SRS-22, Scoliosis Research Society-22; VAS, Visual Analogue Scale.

rates have on satisfaction, we have been able to more closely assess the effect of complications on the same satisfaction outcome measure. In continuity with the trend of their findings, our study of a larger population suggests that the occurrence of postoperative complications does not have a significant effect on satisfaction. This challenges Emami *et al*'s smaller, single center study of 54 ASD patients in 2002.²⁹ More specifically, they found that perioperative complications and postoperative pseudoarthrosis were associated with significant decreases in satisfaction scores.²⁹ While their latter finding is supported by the work of Scheer *et al*,²⁸ subgroup analysis of specific complication types was not performed in our study. As for the effect of perioperative complications on satisfaction, as illustrated in Figure 1, complications in this larger, multicenter study were not associated with decreased satisfaction at early follow-up.

Despite uncertainty regarding current methods for measuring patient satisfaction, patient care evaluation is in the midst of shifting its focus from the health care provider's perspective to a model that is more inclusive of the patient's experience. In doing so, caution must be maintained while attempting to objectively answer questions such as, "Has a health need been met?", "Was the care satisfactory?", and "Has the burden of disease on the patient's quality of life been minimized?"³⁰ Based on our results, the SRS-22r satisfaction domain appears to have at best a moderate correlation to surgical goals of improved function, reduced pain, and improvement of spinal

alignment. Further research will be needed to better understand the drivers of patient satisfaction, as well as the ability to measure patient satisfaction in a valid way.

The satisfaction domain of the SRS-22r did demonstrate a potential ceiling effect, in that greater than 50% of the population studied scored greater than or equal to 4 out of 5. This has been demonstrated in the previous literature on spinal deformity surgery and satisfaction.^{7,31} Clustering of patient's self-reported satisfaction may represent a true treatment effect or potential response shift, whereby recollection of baseline disability may change over time.^{32,33} However, the ceiling effect may also reflect a lack of discrimination in the SRS-22 satisfaction domain itself. Given that the SAT domain comprises only two overlapping questions, each with only five potential responses, it is possible that it does not give a full assessment of true patient satisfaction.

An important limitation of the present study is that it is a retrospective analysis. This introduces susceptibility to unidentified confounders and both selection and information bias. These biases were mitigated, however, by the fact that the data was collected in a prospective manner. In addition, this analysis provides the first multicenter evaluation of this topic.

Another potential limitation to this study was that more comprehensive information on potential drivers of patient satisfaction could not be collected. Determinants of satisfaction in other patient populations include good patient mental well-being, optimistic surgeon expectations, and postoperative fulfillment of patient expectations.⁵ Other evaluations

TABLE 4. Correlation Coefficient Between SRS-22 Satisfaction and Radiographic Parameters at Final Follow-up and Change From Baseline

Correlation Coefficient (<i>r</i>) Between Satisfaction and Final Follow-Up or Change From Baseline				
Radiographic Parameter	Final Follow-Up	<i>P</i> Value	Change From Baseline	<i>P</i> Value
Coronal plumbline (mm)	−0.05	0.41	0.03	0.64
Lumbar lordosis (degrees)	0.09	0.18	−0.05	0.42
Sagittal vertical axis (mm)	0.02	0.78	−0.01	0.89
Pelvic tilt (degrees)	0.15	0.02	0.00	0.99
T1 pelvic angle (degrees)	−0.12	0.06	−0.01	0.91
Pelvic incidence/lumbar lordosis mismatch (degrees)	−0.032	0.63	−0.03	0.64

SRS-22 indicates Scoliosis Research Society-22.

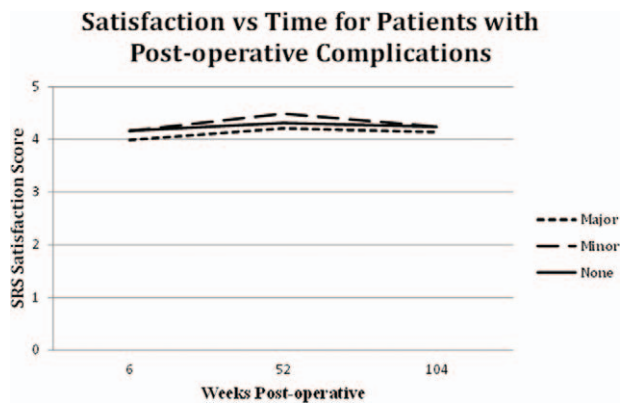


Figure 1. Patient satisfaction over time after postoperative complications.

have shown that the greatest contributor to satisfaction is the patient's judgment of their relationship with their provider.⁶ We are unable to assess these issues with our data set. Given the lack of strong correlations found with our study variables, it may be that features such as these are more important as drivers of patient satisfaction.

The patient satisfaction domain within the SRS-22r questionnaire has a moderate correlation with HRQoLs, and minimal correlation with radiographic parameters or the occurrence of postoperative complications. These findings represent an important step toward bridging previous literature on predictors of clinical outcome with future studies on patient satisfaction. It also lays groundwork for economic analysis through comparing satisfaction scores with HRQoL-derived economic evaluation scores. While HRQoLs, radiographic correction, and complication rates should not lose their clinical importance, this study demonstrates how these outcomes are perhaps more parallel to, rather than entrenched within, the postoperative ASD patient's experience of satisfaction. In order for postoperative satisfaction to be better attained and understood, a more sophisticated measurement tool will need to be developed. Factors that may have a greater role in determining patient satisfaction may include surgical goals, preoperative expectations, and the evolving surgeon–patient relationship.

➤ Key Points

- Complications and radiographic changes do not correlate with patient satisfaction.
- SF-36 measures and ODI scores show a moderate correlation with patient satisfaction.
- Surgeons should consider a patient's preoperative expectation as well as their rapport with their patient as other potential drivers of satisfaction.

References

1. Roitberg BZ, Thaci B, Auffinger B, et al. Comparison between patient and surgeon perception of degenerative spine disease

outcomes—a prospective blinded database study. *Acta Neurochir* 2013;155:757–64.

2. Hart RA, Marshall LM, Hiratzka SL, et al. Functional limitations due to stiffness as a collateral impact of instrumented arthrodesis of the lumbar spine. *Spine (Phila Pa 1976)* 2014;39:E1468–74.
3. Sciubba DM, Scheer JK, Smith JS, et al., International Spine Study Group (ISSG). Which daily functions are most affected by stiffness following total lumbar fusion: comparison of upper thoracic and thoracolumbar proximal endpoints. *Spine (Phila Pa 1976)* 2015;40:1338–44.
4. Mannion AF, Leivseth G, Brox JI, et al. ISSLS Prize winner: long-term follow-up suggests spinal fusion is associated with increased adjacent segment disc degeneration but without influence on clinical outcome: results of a combined follow-up from 4 randomized controlled trials. *Spine (Phila Pa 1976)* 2014;39:1373–83.
5. Palazzo C, Jourdan C, Descamps S, et al. Determinants of satisfaction 1 year after total hip arthroplasty: the role of expectations fulfilment. *BMC Musculoskelet Disord* 2014;15:53.
6. Famiglietti RM, Neal EC, Edwards TJ, et al. Determinants of patient satisfaction during receipt of radiation therapy. *Int J Radiat Oncol Biol Phys* 2013;87:148–52.
7. Gum JL, Bridwell KH, Lenke LG, et al. SRS22R appearance domain correlates most with patient satisfaction after adult deformity surgery to the sacrum at 5-year follow-up. *Spine (Phila Pa 1976)* 2015;40:1297–302.
8. Carreon LY, Sanders JO, Diab M, et al. Patient satisfaction after surgical correction of adolescent idiopathic scoliosis: correlations with SRS-22 domain scores. *Spine (Phila Pa 1976)* 2011; 36:965–8.
9. Mannion AF, Elfering A, Staerke R, et al. Predictors of multidimensional outcome after spinal surgery. *Euro Spine J* 2007;16:777–86.
10. Hamilton DK, Smith JS, Sansur CA, et al. C-2 neurectomy during atlantoaxial instrumented fusion in the elderly: patient satisfaction and surgical outcome. *J Neurosurg Spine* 2011;15:3–8.
11. Hall JA, Milburn MA, Epstein AM. A causal model of health status and satisfaction with medical care. *Med Care* 1993;31:84–94.
12. Kane RL, Maciejewski M, Finch M. The relationship of patient satisfaction with care and clinical outcomes. *Med Care* 1997;35:714–30.
13. Strasser S, Aharony L, Greenberger D. The patient satisfaction process: moving toward a comprehensive model. *Med Care Rev* 1993;50:219–48.
14. Chow A, Mayer EK, Darzi AW, et al. Patient-reported outcome measures: the importance of patient satisfaction in surgery. *Surgery* 2009;146:435–43.
15. Godil SS, Parker SL, Zuckerman SL, et al. Determining the quality and effectiveness of surgical spine care: patient satisfaction is not a valid proxy. *Spine J* 2013;13:1006–12.
16. Hart RA, Cabalo A, Bess S, et al. Comparison of patient and surgeon perceptions of adverse events after adult spinal deformity surgery. *Spine (Phila Pa 1976)* 2013;38:732–6.
17. Hoff RA, Rosenheck RA, Meterko M, et al. Mental illness as a predictor of satisfaction with inpatient care at Veterans Affairs hospitals. *Psychiatr Serv* 1999;50:680–5.
18. Kleinstueck FS, Fekete TF, Jeszenszky D, et al. Adult degenerative scoliosis: comparison of patient-rated outcome after three different surgical treatments. *Eur Spine J* 2016;25:2649–56.
19. Mannion AF, Mutter UM, Fekete FT, et al. The bothersomeness of patient self-rated “complications” reported 1 year after spine surgery. *Eur Spine J* 2012;21:1625–32.
20. Bess S, Akbarnia BA, Thompson GH, et al. Complications of growing-rod treatment for early-onset scoliosis: analysis of one hundred and forty patients. *J Bone Joint Surg Am* 2010;92:2533–43.
21. Bess S, Boachie-Adjei O, Burton D, et al. Pain and disability determine treatment modality for older patients with adult scoliosis, while deformity guides treatment for younger patients. *Spine (Phila Pa 1976)* 2009;34:2186–90.
22. Cho SK, Bridwell KH, Lenke LG, et al. Comparative analysis of clinical outcome and complications in primary versus revision adult scoliosis surgery. *Spine (Phila Pa 1976)* 2012;37: 393–401.

23. Carreon LY, Sanders JO, Diab M, et al. The minimum clinically important difference in Scoliosis Research Society-22 Appearance, Activity, And Pain domains after surgical correction of adolescent idiopathic scoliosis. *Spine* 2010;35:2079–83.
24. Scheer JK, Tang JA, Smith JS, et al. Reoperation rates and impact on outcome in a large, prospective, multicenter, adult spinal deformity database: clinical article. *J Neurosurg Spine* 2013;19:464–70.
25. Glassman SD, Hamill CL, Bridwell KH, et al. The impact of perioperative complications on clinical outcome in adult deformity surgery. *Spine (Phila Pa 1976)* 2007;32:2764–70.
26. Glassman SD, Berven S, Bridwell K, et al. Correlation of radiographic parameters and clinical symptoms in adult scoliosis. *Spine (Phila Pa 1976)* 2005;30:682–8.
27. Schwab FJ, Blondel B, Bess S, et al., International Spine Study Group (ISSG). Radiographical spinopelvic parameters and disability in the setting of adult spinal deformity: a prospective multicenter analysis. *Spine (Phila Pa 1976)* 2013;38:E803–12.
28. Scheer JK, Mundis GM, Klineberg E, et al., International Spine Study Group (ISSG). Recovery following adult spinal deformity surgery: the effect of complications and reoperation in 149 patients with 2-year follow-up. *Eur Spine J* 2016;25:2612–21.
29. Emami A, Deviren V, Berven S, et al. Outcome and complications of long fusions to the sacrum in adult spine deformity: luque-galveston, combined iliac and sacral screws, and sacral fixation. *Spine (Phila Pa 1976)* 2002;27:776–86.
30. Asadi-Lari M, Tamburini M, Gray D. Patients' needs, satisfaction, and health related quality of life: towards a comprehensive model. *Health Qual Life Outcomes* 2004;2:32.
31. Parent EC, Dang R, Hill D, et al. Score distribution of the scoliosis research society-22 questionnaire in subgroups of patients of all ages with idiopathic scoliosis. *Spine* 2010;35:568–77.
32. Sprangers MA, Schwartz CE. Integrating response shift into health-related quality of life research: a theoretical model. *Soc Sci Med (1982)* 1999;48:1507–15.
33. Sprangers MA, Van Dam FS, Broersen J, et al. Revealing response shift in longitudinal research on fatigue—the use of the thetest approach. *Acta Oncol* 1999;38:709–18.