
Comparative study of the use of Pediatric Quality of Life Inventory™ 4.0 Generic Core Scales in pediatric patients with spine and limb pathologies

1 ***Abstract***

2 ***Aims***

3 The health-related quality of life (HRQoL) of pediatric patients with orthopaedic conditions and
4 spinal deformity is important, but existing generic tools have their shortcomings. We aim to
5 evaluate the use of Pediatric Quality of Life Inventory™ (PedsQL™) 4.0 Generic Core Scales in
6 the pediatric population with specific comparisons between those with spinal and limb pathologies,
7 and to explore the feasibility of using PedsQL for studying scoliosis patients' HRQoL.

8 ***Patients and Methods***

9 Pediatric patients attending a specialty outpatient clinic were recruited through consecutive
10 sampling. Two groups of patients were included: idiopathic scoliosis, pediatric orthopaedic upper
11 and lower limb condition without scoliosis. Patients were asked to complete: PedsQL 4.0 Generic
12 Core Scales, Youth version of 5-level EuroQol-5-dimension and Refined Scoliosis Research
13 Society 22-item(SRS-22r). Statistical analyses included scores comparison between scoliosis and
14 limb pathology patients using independent t-test, correlation tests of PedsQL and SRS-22r.

15 ***Results***

16 A total of 566 pediatric patients were recruited: 357 (63.0%) having idiopathic scoliosis, 209
17 (37.0%) with limb conditions. Patients with limb pathology had lower functioning scale, summary
18 and total scores of PedsQL than scoliosis patients ($p < 0.05$ to $p < 0.001$). No floor nor ceiling effects
19 ($< 15\%$) were detected for PedsQL Psychosocial Health Summary and total scores in both groups.

1 PedsQL was sensitive in differentiating patients with/without problems in their daily lives ($p < 0.05$
2 to $p < 0.01$). PedsQL summary and total scores correlated with SRS-22r total score.

3 ***Conclusion***

4 PedsQL is an effective HRQoL measure for both pediatric orthopedic groups with minimal ceiling
5 and floor effects, and is capable of detecting worse HRQoL in patients with limb pathology. The
6 multidimensional PedsQL is sensitive in differentiating among those with daily life problems,
7 especially for scoliosis patients.

1 ***Introduction***

2 Pediatric patients can be presented with numerous conditions and health issues, ranging
3 from acute injuries resulting from falls to chronic conditions from neuromuscular disorders and
4 syndromes. The success of managing pediatric patients not only lies in the treatment of their
5 conditions, but equally important the psychosocial aspect and health-related quality of life
6 (HRQoL) of these growing patients. The assessment of HRQoL, especially in chronic conditions,
7 is part of a standard clinical care. For pediatric orthopaedic patients, spinal deformity is one
8 prominent disease entity. Scoliosis is a three-dimensional spinal deformity involving vertebral
9 rotation, which can result in concerns of aesthetics, compromised function and gait even in mild
10 scoliosis.^{1,2} The onset of idiopathic scoliosis spans the pre-pubertal and pubertal growth period,
11 with curve progression occurring during the pubertal growth spurt.³ These are the crucial periods
12 of child development in terms of body habitus, mental health and social interaction. Another
13 important area of pediatric orthopaedics is upper and lower limb pathologies including fractures,⁴
14 growth abnormalities and hip dysplasia.⁵ These may lead to difficulties in social activities, sports,
15 schooling, and may result in significant mental burden. Similar to scoliosis, these conditions may
16 also deteriorate through growth leading to increased limb length discrepancies and deformities.
17 HRQoL of pediatric patients is important for clinicians to gauge how diseases or conditions can
18 impact patient's general well-being. An appropriate patient-reported generic outcome measure
19 allows HRQoL to be elicited effectively, and acts as a common tool for comparison between
20 diseases.

21 Previous studies have validated generic instrument to be used in the pediatric and pediatric
22 orthopaedic populations in particular,^{6,7} such as the Pediatric Quality of Life InventoryTM (PedsQL)
23 4.0 generic core scales. PedsQL is equipped with items dedicated for the physical, emotional and

1 especially school functioning aspects. However, PedsQL was never used as a primary outcome in
2 younger idiopathic scoliosis patients previously.⁸⁻¹⁰ Validated generic tools for the idiopathic
3 scoliosis population, for example the 5-level EuroQol-5-dimension (EQ-5D-5L) and youth version
4 of 5-level EuroQol-5-dimension (EQ-5D-5L-Y) often demonstrate high ceiling effect,¹¹⁻¹³ possibly
5 due to the scoliosis disease nature or lack of items tailored for pediatric patients. A floor or ceiling
6 effect is defined as more than 15% of respondents achieving the lowest or highest possible score
7 of an instrument,^{14, 15} These are potential measurement limitations which indicate such instrument
8 may not be sensitive to changes or variation.^{16, 17} This can lead to a decreased likelihood of
9 measuring HRQoL accurately.

10 As such, this study aims to evaluate the use of PedsQL 4.0 Generic Core Scales in the
11 pediatric population with specific comparisons between lower limb and spinal pathologies. In
12 addition, this is the first feasibility study of using PedsQL as a primary outcome measure for
13 studying scoliosis patients' quality of life. Hypotheses included PedsQL has better ceiling effects
14 than EQ-5D-5L-Y, PedsQL would demonstrate differences in scores among pediatric orthopaedic
15 patients, and that the scores of PedsQL would be correlated with those of the Refined Scoliosis
16 Research Society 22-item (SRS-22r) questionnaire.

17

18 ***Patients and Methods***

19 *Study design and patient recruitment*

20 This was a prospective study with consecutive sampling of patients attending a tertiary
21 referral paediatric orthopaedic clinic. Two groups of patients were recruited: idiopathic scoliosis,
22 pediatric limb conditions without scoliosis. Patients who were diagnosed with juvenile idiopathic

1 scoliosis (being diagnosed at 4 to 10 years of age) and adolescent idiopathic scoliosis (occurs
2 between the age of 10 to 18 years)¹⁸ were included, as well as patients presented with any pediatric
3 orthopaedic upper and lower limb condition without co-existing scoliosis. Patients who were
4 diagnosed with other forms of scoliosis (non-idiopathic), or those with delayed global development
5 and intellectual disability, and patients who could not fully understand and communicate in
6 Chinese were excluded. For determining the size of the study population, the principal of subjects-
7 to-variables ratio was adopted. As there is a total of 23 items in PedsQL, the targeted ratio of
8 subjects-to-variables was 20:1.¹⁹ All patients fitting the inclusion criteria were approached by
9 research personnel and were asked to complete a set of questionnaires: PedsQL 4.0 Generic Core
10 Scales (Child self-report, ages 8-12 years or 13-18 years version, according to the age at
11 recruitment), EQ-5D-5L-Y and SRS-22r prior to the doctor's consultation. Patient and parents'
12 consents were gained and this study was approved by the local ethics committee.

13

14 *Patient outcome measures*

15 *Pediatric Quality of Life Inventory (PedsQL)*

16 PedsQL 4.0 Generic Core Scales is a patient-reported outcome measure consists of 23
17 items in assessing the HRQoL in the pediatric population.^{6, 20} It has been cross-culturally adapted
18 and validated in the local pediatric population,^{21, 22} as well as ~~being validated with reliability in~~
19 ~~other countries.~~²³⁻²⁸ Its psychometric properties were found satisfactory in various disease groups
20 like pediatric patients with cancers, cardiovascular disease, psychiatric problems, and Duchenne
21 muscular dystrophy.^{26, 29-33} It was also found sensitive in distinguishing healthy children from
22 those with chronic conditions.³⁴

1 There are four functioning scales (Physical Functioning, Emotional Functioning, Social
2 Functioning, School Functioning), from which three summary scores are calculated: Total Scale
3 Score (23 items), Physical Health Summary Score (8 items) and Psychosocial Health Summary
4 Score (15 items). Physical Health Summary Score equates to the Physical Functioning Scale score.
5 PedsQL 4.0 Generic Core Scales has four versions and can be administered according to the age
6 of the child: 2–4 years, 5–7 years, 8–12 years and 13–18 years. As children attending our specialty
7 clinic consists of mainly pediatric outpatients, and referrals from the school screening of
8 scoliosis,³⁵ the 8-12 and 13-18 years version were considered the appropriate versions for these
9 groups of patients.

10 *Youth version of the 5-level EuroQol-5-dimension (EQ-5D-5L-Y)*

11 EQ-5D-5L-Y has been developed with 5 level of responses (No problem, a little bit
12 problems, some problems, a lot of problems and extreme problems/cannot) for each of the five
13 EQ-dimensions. Validation and examination of the psychometric properties of EQ-5D-5L-Y were
14 performed in the local paediatric patients with idiopathic scoliosis.^{13, 36} As compared to the EQ-
15 5D-Y with three response levels, EQ-5D-5L-Y has significantly reduced ceiling effects in the
16 dimensions of doing usual activities and feeling worried/sad/unhappy in patients with idiopathic
17 scoliosis.¹³

18 *Refined Scoliosis Research Society 22-item (SRS-22r)*

19 SRS-22r is a disease-specific instrument with 22 items contributing to five domains:
20 Function, Pain, Self-image/appearance, Mental Health, Satisfaction with Treatment. Individual
21 domain score and a total score of the SRS-22r can be generated. Its use was validated in the local
22 idiopathic scoliosis population.³⁷

1 Patient demographic information was collected, including age, body height and weight,
2 body mass index (kilograms/metres²). Also, diagnosis and treatment modalities of these pediatric
3 patients were recorded.
4

5 *Statistical analysis*

6 Descriptive statistics of patient demographics and scores of questionnaires were presented.
7 For each of the questionnaires (PedsQL, EQ-5D-5L-Y and SRS-22r), the ceiling and floor effects
8 were examined. Functioning scale and summary scores of PedsQL 4.0 were compared for the spine
9 and lower limb pathologies patients using the independent samples *t*-test. Comparison of the
10 distribution of EQ-5D-5L-Y between the two pediatric orthopaedic groups was performed by Chi-
11 squared test for detecting any difference in their daily lives. For each pediatric patient group, the
12 sensitivity of PedsQL was explored by comparing patients with problems (mild to severe problem,
13 as indicated by EQ-5D-5L-Y, level response 2 to 5) versus those without problems (EQ-5D-5L-Y,
14 level 1 response) in the five EQ-dimensions (mobility, looking after myself, doing usual activities,
15 having pain or discomfort, and feeling worried, sad or unhappy). The correlations between PedsQL
16 and SRS-22r questionnaires, and the relationship of scoliotic curve magnitude and SRS-22r scores
17 were also examined using Spearman's rho correlation test. The curve types (thoracic,
18 thoracolumbar/lumbar, double curves (similar-sized thoracic and thoracolumbar/lumbar curves)
19 were tested for any associations with the domain and total scores of SRS-22r using Kruskal-Wallis
20 H test and eta-squared (η^2).

21 Statistical analyses were performed using SPSS Windows 24.0 (IBM SPSS Inc., Chicago,
22 Illinois). Statistical significance was considered at a p-value <0.05.

1

2 **Results**

3 There was a total of 566 pediatric patients recruited, with 357 patients (63.0%) having
4 idiopathic scoliosis and 209 (37.0%) with limb conditions. The mean age of the study population
5 filled in the PedsQL 8-12 years and 13-18 years versions was 10.8 ± 1.3 years, and 14.3 ± 1.2 years
6 respectively.(Table 1) For the limb pathology group, the most frequently presented conditions
7 were fractures or injuries (43.5%), followed by 27.3% having flat feet with/without leg length
8 discrepancy. Monitoring or conservative treatment was utilized for 52.5% of patients with limb
9 pathology, insoles or medial arch support was utilized for 18.2% of these patients, arm sling/arm
10 or leg casting was utilized for 13.4%, and stretching exercises and physiotherapies were chosen
11 for 12.0% of these patients. For scoliosis patients, the mean major Cobb angle was $26.1^\circ \pm 8.4^\circ$
12 and mean minor Cobb angle was $20.8^\circ \pm 7.4^\circ$, with 45.2% thoracic curves, 42.7%
13 thoracolumbar/lumbar curves and 12.1% double curves. There were 36.1% of scoliosis patients
14 under observation only, 29.7% were presented for initial consultation upon referrals, 26.1% were
15 undergoing bracing, with only 2.2% returning for follow-up with previous surgery.

16 Based on the PedsQL responses,(Appendix) pediatric patients with lower limb pathology
17 had significantly lower scores for all functioning scales, summary and total scores than their
18 scoliosis peers ($p < 0.05$ to $p < 0.001$),(Table 2) except for those aged 13-18 years with no significant
19 difference of Social Functioning scale score ($p = 0.31$). The total score and Psychosocial Health
20 Summary score of PedsQL had no floor nor ceiling effects ($< 15\%$) in both groups, but the ceiling
21 effects were higher for scoliosis patients in all scales/summary/total scores in general.(Table 2)
22 Patients of 13-18 years had relatively lower ceiling effects than their younger peers for both groups.

1 The distribution of EQ-5D-5L-Y responses in both pediatric orthopaedic groups was found
2 significantly different for the following four dimensions: Mobility, Looking after myself, Doing
3 usual activities, Having pain or discomfort.(Table 3) All dimensions of the EQ-5D-5L-Y had high
4 ceiling effects for both groups. For the SRS-22r questionnaire (Table 4), each domain and the total
5 scores had no floor effects, but ceiling effect was highest for the domain of Pain (59.7%), followed
6 by the Self-image (49.8%) and Mental Health domains (28.3%).

7 In Table 5, PedsQL was found sensitive in differentiating among scoliosis patients (8-12
8 & 13-18 years) experiencing mild to severe mobility problem (as indicated by EQ-5D-5L-Y, level
9 response 2 to 5) from those without (EQ-5D-5L-Y response level 1), with significantly lower
10 Physical Functioning scale score, Physical Health Summary score, Psychosocial Health Summary
11 score and total score of PedsQL ($p<0.05$ to $p<0.01$). In addition, the 13-18 years old scoliotic
12 patients with mobility problems had worse Emotional, Social and School Functioning scale scores
13 (all at $p<0.01$). For scoliosis patients aged 8-12 years having problems of self-care and doing usual
14 activities, their Physical Functioning scale, Physical Health Summary and total scores of PedsQL
15 were significantly lower. Moreover, scoliosis patients (8-12 & 13-18 years) suffering
16 pain/discomfort were depicted by significantly lower Physical, Emotional and School Functioning
17 scale scores, and also lower Psychosocial and Physical Health Summary scores and total score of
18 PedsQL. Those who were feeling worried, sad or unhappy had significantly lower Emotional,
19 Social and School Functioning scale scores, Psychosocial Health Summary and total scores in the
20 8-12 years old, but also significantly worse Physical Functioning and Physical Health Summary
21 Scores in their older scoliosis peers. Specifically, the School Functioning scale of PedsQL
22 exhibited significantly lower score in all scoliosis patients who were feeling pain/discomfort, or
23 worried/sad/unhappy.

1 In contrast, for patients with limb pathology aged 13-18 years, those with mobility
2 problems had only worse Physical Functioning scale and Physical Health Summary scores instead
3 of all scores/subscores being affected as in the 13-18 years scoliosis patients. The same applied to
4 those having pain/discomfort, which did not reflect through as many scores as their same-aged
5 scoliosis peers (not significantly lower Emotional and School Functioning, and Psychosocial
6 Health Summary and total scores as in scoliosis patients). But for younger (8-12 years) limb
7 pathology patients, mobility problem involved lower Emotional Functioning scale score whereas
8 those with self-care problems had lower School Functioning and Psychosocial Health Summary
9 scores as well – these were in addition to what were found for the same-aged scoliosis peers. For
10 those who were feeling worried/sad/unhappy, all functioning scales, summary and total scores
11 were lower only for the 8-12 years old.

12 For patients with scoliosis, the domain scores of Function of SRS-22r correlated
13 significantly with curve magnitudes for those aged 8-12 years, whereas older scoliosis patients
14 have Self-image domain scores negatively correlated with curve magnitude ($p < 0.05$). (Table 6) No
15 significant difference of SRS-22r scores was found among various curve types, and no significant
16 effect of each curve type in association with the variance (η^2 in percentage, ranged from 0% to 3%)
17 of SRS-22r scores. (Table 6) The Psychosocial Health Summary Score, Physical Health Summary
18 Score and total score of PedsQL were found correlated with the SRS-22r total score for all scoliosis
19 patients. (Table 6) Older scoliosis patients (13-18 years) had both PedsQL summary scores and
20 total score correlated significantly with each of the SRS-22r domain scores, except the Satisfaction
21 with Treatment domain.

22

23 ***Discussion***

1 The understanding of young patients' HRQoL throughout their period of growth may
2 benefit patient care. The elicitation of HRQoL can best be facilitated by the most appropriate
3 patient-reported outcome measure which caters for the characteristics of a disease or condition. A
4 generic instrument is essential for comparison between disease entities, as well as the calculation
5 of quality-adjusted life year (QALY) for health economics.³⁸ Previous studies have found that EQ-
6 5D-Y had a very high ceiling effect in general children and adolescent populations³⁹ The ceiling
7 effect of EQ-5D-5L in the local adolescent idiopathic scoliosis population could be as high as
8 66.0%,¹¹ thus posing a limited capability of detecting any changes of HRQoL in patients with
9 mild to moderate impairment.³⁹ In search of a multidimensional outcome tool covering aspects
10 like school life, social life and emotional functioning, PedsQL was selected as it was found capable
11 of differentiating between healthy pediatric population and those with acute or chronic
12 conditions.^{20, 40} In this study, by comparing patients with limb and spinal pathologies in the same
13 setting of specialty outpatient clinic, it is possible to explore and evaluate the feasibility of the use
14 of PedsQL in these young patients with specific orthopaedic conditions. The hypotheses of
15 PedsQL having better ceiling effects than EQ-5D-5L-Y and the ability to demonstrate differences
16 in its scores among pediatric orthopaedic patients are tested and found to be supported by the
17 results. PedsQL is also found correlated with the SRS-22r scores for patients with idiopathic
18 scoliosis.

19 As an instrument exhibits a floor or ceiling effect if more than 15% of respondents have
20 the respective highest or lowest scores,¹⁴ our findings indicate that the total score and Psychosocial
21 Health Summary score of PedsQL (8-12 years & 13-18 years versions) have neither floor nor
22 ceiling effects for both groups. However, the ceiling effects of Physical Health Summary Score
23 for scoliosis patients are 41.0% and 37.3% for the 8-12 years and 13-18 years respectively. All

1 ceilings effects are higher in the scoliosis than in the limb pathology group. This highlights the
2 characteristics of scoliosis patients and the challenges posing for a generic instrument to be used
3 in this spinal deformity group. In comparison, PedsQL has much lower ceiling effects than the
4 EQ-5D-5L-Y whose ceiling effect was highest for the ‘Looking after yourself’ dimension at 97.2%
5 (scoliosis patients). Also, high ceiling effects of 75.4% (spine) and 67.9% (limb) for the EQ-5D
6 dimension ‘Feeling worried, sad or unhappy’ were found as compared to no ceiling effect of
7 Psychosocial Health Summary Score of PedsQL for both groups.

8 Interestingly, For patients who presented mainly for injuries/fractures or flat feet in the
9 limb pathology group, they were found to have worse HRQoL than patients with idiopathic
10 scoliosis. Scoliosis impacts the appearance of paediatric patients and our results support this by
11 correlations with the patients’ perception of own appearance (for 13-18 years) and function (for 8-
12 12 years). Psychosocial Health and Physical Health Summary scores and total score of PedsQL
13 were demonstrated significantly lower for those with limb pathology. However, this worse HRQoL
14 requires insight into the individual disease profiles as there are more difficulties in mobility (21.5%
15 of limb pathology patients have mild problem versus 6.7% of scoliosis patients), as well as greater
16 hinderance with treatment like casting (19.1% limb pathology patients have mild problem with
17 daily activities versus 8.4% of scoliosis patients), or even pain severity from trauma (28.2% limb
18 pathology patients were experiencing pain/discomfort). The mean and median summary and total
19 PedsQL scores of <90.0 for limb pathology patients versus ≥ 90.0 for scoliosis patients of this study
20 can give pediatricians an indication of the average score values for this pediatric population, and
21 serves as a benchmark for further investigation of HRQoL of particular pediatric orthopaedic
22 conditions.

1 Our findings reveal that the PedsQL is sensitive in differentiating pediatric patients who
2 perceive themselves experiencing problems in daily life even in the mild degree, from those who
3 have no problems at all. PedsQL demonstrated such ability of differentiation by expressing
4 significantly lower functioning scale and summary scores and total scores for patients having just
5 mild problems in mobility, looking after oneself, doing usual activities (such as schooling, leisure
6 activities or exercises), with any pain/discomfort or feeling worried, sad or unhappy, as compared
7 to those without problems (since the next majority of responses for EQ-5D-5L-Y were ‘mild/a
8 little bit problems’ following those with ‘no problems’). This sensitivity was found consistently in
9 all scoliosis patients, and only for the limb pathology group of 8-12 years.

10 In addition, the discrepancy between patients with no mobility problems and those with
11 (mild to severe) problems were elicited not only in the physical-related scales of PedsQL, the
12 Emotional and Social Functioning scales scores also demonstrate significant difference, resulting
13 in the much lower score of 73.3 for Psychosocial Health Summary score for the 13-18 year-old
14 scoliosis patients. For patients aged 8-12 years having problems (mild to severe problems) in
15 ‘doing usual activities’ as compared to those without problems, the limb deformity patients have
16 lower summary and total scores in particular for psychosocial health, emotional and social
17 functioning. This was not detected in their scoliosis same-aged peers however. In addition,
18 Physical Functioning scale was found involved in both scoliosis (13-18 years) and limb pathology
19 (8-12 years) patients who were feeling worried, sad or unhappy. Therefore, the multidimensional
20 items of PedsQL and its ability to demonstrate difference at the individual functioning scale level
21 allow clinicians to gain refined HRQoL information, and suggest what possible components may
22 have contributed to a certain aspect of compromised HRQoL.

1 The main limitations for this study were the uneven patient population sizes of the two
2 groups, and the various diagnoses in the limb pathology group. Also, parents of these pediatric
3 patients should also be invited to provide parent-proxy report, in order to ascertain what is the role
4 of the parent-provided information in the assessment of the patient's HRQoL. In the future, the
5 responsiveness of PedsQL should be investigated, and also for treatment-specific comparisons and
6 to assess whether the instrument is receptive to the severity of scoliosis.

7 Our study has demonstrated that PedsQL can be an effective generic outcome measure of
8 the HRQoL of patients with pediatric orthopaedic conditions, with minimal floor and ceiling
9 effects. PedsQL is capable of detecting worse HRQoL in those with limb pathology as compared
10 to idiopathic scoliosis. Moreover, PedsQL is found sensitive among patients with self-perceived
11 mild problems in their daily lives, especially for the scoliosis patients. Together with the sensitive
12 functioning scale scores, the multidimensional PedsQL can provide valuable information
13 suggestive of what specific aspects could be affected in the HRQoL of pediatric patients with spine
14 and limb pathologies.

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1 **References**

- 2 1. Choudhry MN, Ahmad Z and Verma R. Adolescent Idiopathic Scoliosis. *The open*
3 *orthopaedics journal* 2016; 10: 143-154. 2016/06/28. DOI: 10.2174/1874325001610010143.
- 4 2. Mahaudens P, Banse X, Mousny M, et al. Gait in adolescent idiopathic scoliosis:
5 kinematics and electromyographic analysis. *European spine journal : official publication of the*
6 *European Spine Society, the European Spinal Deformity Society, and the European Section of the*
7 *Cervical Spine Research Society* 2009; 18: 512-521. 2009/02/19. DOI: 10.1007/s00586-009-0899-
8 7.
- 9 3. Charles YP, Daures JP, de Rosa V, et al. Progression risk of idiopathic juvenile scoliosis
10 during pubertal growth. *Spine* 2006; 31: 1933-1942. 2006/08/23. DOI:
11 10.1097/01.brs.0000229230.68870.97.
- 12 4. Jones IE, Williams SM, Dow N, et al. How many children remain fracture-free during
13 growth? a longitudinal study of children and adolescents participating in the Dunedin
14 Multidisciplinary Health and Development Study. *Osteoporosis international : a journal*
15 *established as result of cooperation between the European Foundation for Osteoporosis and the*
16 *National Osteoporosis Foundation of the USA* 2002; 13: 990-995. 2002/12/03. DOI:
17 10.1007/s001980200137.
- 18 5. Bruce D, Kocialkowski C, Bintcliffe F, et al. Analysis of a paediatric orthopaedic network:
19 a six-year experience in the South West of the United Kingdom. *Journal of children's orthopaedics*
20 2017; 11: 404-413. 2017/10/31. DOI: 10.1302/1863-2548.11.170076.

- 1 6. Varni JW, Burwinkle TM, Seid M, et al. The PedsQL 4.0 as a pediatric population health
2 measure: feasibility, reliability, and validity. *Ambulatory pediatrics : the official journal of the*
3 *Ambulatory Pediatric Association* 2003; 3: 329-341. 2003/11/18.
- 4 7. Mahan ST, Kalish LA, Connell PL, et al. PedsQL correlates to PODCI in pediatric
5 orthopaedic outpatient clinic. *Journal of pediatric orthopedics* 2014; 34: e22-26. 2014/10/03.
- 6 8. Weinstein SL, Dolan LA, Wright JG, et al. Effects of bracing in adolescents with idiopathic
7 scoliosis. *The New England journal of medicine* 2013; 369: 1512-1521. 2013/09/21. DOI:
8 10.1056/NEJMoa1307337.
- 9 9. Theroux J, Stomski N, Hodgetts CJ, et al. Tracking low back pain in adolescent idiopathic
10 scoliosis: a prospective cohort study protocol. *Chiropractic & manual therapies* 2017; 25: 22.
11 2017/09/08. DOI: 10.1186/s12998-017-0155-x.
- 12 10. Schwieger T, Campo S, Weinstein SL, et al. Body Image and Quality of Life and Brace
13 Wear Adherence in Females With Adolescent Idiopathic Scoliosis. *Journal of pediatric*
14 *orthopedics* 2017; 37: e519-e523. 2016/02/18. DOI: 10.1097/bpo.0000000000000734.
- 15 11. Cheung PWH, Wong CKH, Samartzis D, et al. Psychometric validation of the EuroQoL 5-
16 Dimension 5-Level (EQ-5D-5L) in Chinese patients with adolescent idiopathic scoliosis. *Scoliosis*
17 *Spinal Disord* 2016; 11: 19. 2016/08/16. DOI: 10.1186/s13013-016-0083-x.
- 18 12. Wong CKH, Cheung PWH, Samartzis D, et al. Mapping the SRS-22r questionnaire onto
19 the EQ-5D-5L utility score in patients with adolescent idiopathic scoliosis. *PLoS One* 2017; 12:
20 e0175847. 2017/04/18. DOI: 10.1371/journal.pone.0175847.
- 21 13. Wong CKH, Cheung PWH, Luo N, et al. A head-to-head comparison of five-level (EQ-
22 5D-5L-Y) and three-level EQ-5D-Y questionnaires in paediatric patients. *Eur J Health Econ* 2019;
23 20: 647-656. 2019/01/03. DOI: 10.1007/s10198-018-1026-7.

- 1 14. McHorney CA and Tarlov AR. Individual-patient monitoring in clinical practice: are
2 available health status surveys adequate? *Quality of life research : an international journal of*
3 *quality of life aspects of treatment, care and rehabilitation* 1995; 4: 293-307. 1995/08/01.
- 4 15. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement
5 properties of health status questionnaires. *Journal of clinical epidemiology* 2007; 60: 34-42.
6 2006/12/13. DOI: 10.1016/j.jclinepi.2006.03.012.
- 7 16. The SAGE Encyclopedia of Social Science Research Methods. 2004. DOI:
8 10.4135/9781412950589.
- 9 17. Encyclopedia of Research Design. 2010. DOI: 10.4135/9781412961288.
- 10 18. Donzelli S, Zaina F, Lusini M, et al. In favour of the definition "adolescents with idiopathic
11 scoliosis": juvenile and adolescent idiopathic scoliosis braced after ten years of age, do not show
12 different end results. SOSORT award winner 2014. *Scoliosis* 2014; 9: 7. 2014/07/18. DOI:
13 10.1186/1748-7161-9-7.
- 14 19. Hogarty KY, Hines CV, Kromrey JD, et al. The Quality of Factor Solutions in Exploratory
15 Factor Analysis: The Influence of Sample Size, Communalities, and Overdetermination. 2005; 65:
16 202-226. DOI: 10.1177/0013164404267287.
- 17 20. Varni JW, Seid M and Kurtin PS. PedsQL 4.0: reliability and validity of the Pediatric
18 Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations.
19 *Medical care* 2001; 39: 800-812. 2001/07/27.
- 20 21. Chan LF, Chow SM and Lo SK. Preliminary validation of the Chinese version of the
21 Pediatric Quality of Life Inventory. *International journal of rehabilitation research Internationale*
22 *Zeitschrift fur Rehabilitationsforschung Revue internationale de recherches de readaptation* 2005;
23 28: 219-227. 2005/07/28.

- 1 22. Hao Y, Tian Q, Lu Y, et al. Psychometric properties of the Chinese version of the Pediatric
2 Quality of Life Inventory 4.0 generic core scales. *Quality of life research : an international journal*
3 *of quality of life aspects of treatment, care and rehabilitation* 2010; 19: 1229-1233. 2010/05/18.
4 DOI: 10.1007/s11136-010-9672-y.
- 5 23. Petersen S, Hagglof B, Stenlund H, et al. Psychometric properties of the Swedish PedsQL,
6 Pediatric Quality of Life Inventory 4.0 generic core scales. *Acta paediatrica (Oslo, Norway : 1992)*
7 2009; 98: 1504-1512. 2009/07/03. DOI: 10.1111/j.1651-2227.2009.01360.x.
- 8 24. Kaartina S, Chin YS, Fara Wahida R, et al. Adolescent self-report and parent proxy-report
9 of health-related quality of life: an analysis of validity and reliability of PedsQL 4.0 among a
10 sample of Malaysian adolescents and their parents. *Health and quality of life outcomes* 2015; 13:
11 44. 2015/04/19. DOI: 10.1186/s12955-015-0234-4.
- 12 25. Velez CM, Villada Ramirez AC, Arias AC, et al. [Rasch Model in the Validation of the
13 Paediatric Quality of Life Inventory 4.0 (PedsQL 4.0) in Colombian Children and Adolescents].
14 *Revista colombiana de psiquiatria* 2016; 45: 186-193. 2016/08/30. DOI:
15 10.1016/j.rcp.2015.12.002.
- 16 26. V KA, Onta M and Joshi S. Health-Related Quality of Life of Nepalese Children With
17 Leukemia Using Pediatric Quality of Life Inventory 4.0 Generic Core Scale. *Journal of pediatric*
18 *oncology nursing : official journal of the Association of Pediatric Oncology Nurses* 2017; 34: 322-
19 330. 2017/04/28. DOI: 10.1177/1043454217703593.
- 20 27. Kook SH and Varni JW. Validation of the Korean version of the pediatric quality of life
21 inventory 4.0 (PedsQL) generic core scales in school children and adolescents using the Rasch
22 model. *Health and quality of life outcomes* 2008; 6: 41. 2008/06/04. DOI: 10.1186/1477-7525-6-
23 41.

- 1 28. Amaya-Arias AC, Alzate JP and Eslava-Schmalbach JH. Construct and Criterion Validity
2 of the PedsQL 4.0 Instrument (Pediatric Quality of Life Inventory) in Colombia. *International*
3 *journal of preventive medicine* 2017; 8: 57. 2017/09/14. DOI: 10.4103/ijpvm.IJPVM_194_16.
- 4 29. Yeung NC, Lau JT, Yu XN, et al. Psychometric properties of the Chinese version of the
5 Pediatric Quality Of Life Inventory 4.0 Generic Core scales among pediatric cancer patients.
6 *Cancer nursing* 2013; 36: 463-473. 2012/10/13. DOI: 10.1097/NCC.0b013e31827028c8.
- 7 30. Ji Y, Chen S, Li K, et al. Measuring health-related quality of life in children with cancer
8 living in Mainland China: feasibility, reliability and validity of the Chinese Mandarin version of
9 PedsQL 4.0 Generic Core Scales and 3.0 Cancer Module. *Health and quality of life outcomes* 2011;
10 9: 103. 2011/11/25. DOI: 10.1186/1477-7525-9-103.
- 11 31. Liang R, Chan SHS, Ho FKW, et al. Health-related quality of life in Chinese boys with
12 Duchenne muscular dystrophy and their families. *Journal of child health care : for professionals*
13 *working with children in the hospital and community* 2019: 1367493519857423. 2019/06/22. DOI:
14 10.1177/1367493519857423.
- 15 32. Bastiaansen D, Koot HM, Bongers IL, et al. Measuring quality of life in children referred
16 for psychiatric problems: psychometric properties of the PedsQL 4.0 generic core scales. *Quality*
17 *of life research : an international journal of quality of life aspects of treatment, care and*
18 *rehabilitation* 2004; 13: 489-495. 2004/04/17. DOI: 10.1023/B:QURE.0000018483.01526.ab.
- 19 33. Marino BS, Tomlinson RS, Wernovsky G, et al. Validation of the pediatric cardiac quality
20 of life inventory. *Pediatrics* 2010; 126: 498-508. 2010/09/02. DOI: 10.1542/peds.2009-2973.
- 21 34. Varni JW, Burwinkle TM and Seid M. The PedsQL 4.0 as a school population health
22 measure: feasibility, reliability, and validity. *Quality of life research : an international journal of*

- 1 *quality of life aspects of treatment, care and rehabilitation* 2006; 15: 203-215. 2006/02/10. DOI:
2 10.1007/s11136-005-1388-z.
- 3 35. Luk KD, Lee CF, Cheung KM, et al. Clinical effectiveness of school screening for
4 adolescent idiopathic scoliosis: a large population-based retrospective cohort study. *Spine* 2010;
5 35: 1607-1614. 2010/05/11. DOI: 10.1097/BRS.0b013e3181c7cb8c.
- 6 36. Wong CKH, Cheung PWH, Luo N, et al. Responsiveness of EQ-5D Youth version 5-level
7 (EQ-5D-5L-Y) and 3-level (EQ-5D-3L-Y) in Patients With Idiopathic Scoliosis. *Spine* 2019; 44:
8 1507-1514. 2019/10/22. DOI: 10.1097/brs.0000000000003116.
- 9 37. Cheung KM, Senkoylu A, Alanay A, et al. Reliability and concurrent validity of the
10 adapted Chinese version of Scoliosis Research Society-22 (SRS-22) questionnaire. *Spine* 2007; 32:
11 1141-1145. 2007/05/02. DOI: 10.1097/01.brs.0000261562.48888.e3.
- 12 38. Whitehead SJ and Ali S. Health outcomes in economic evaluation: the QALY and utilities.
13 *British Medical Bulletin* 2010; 96: 5-21. DOI: 10.1093/bmb/ldq033 %J British Medical Bulletin.
- 14 39. Ravens-Sieberer U, Wille N, Badia X, et al. Feasibility, reliability, and validity of the EQ-
15 5D-Y: results from a multinational study. *Quality of life research : an international journal of*
16 *quality of life aspects of treatment, care and rehabilitation* 2010; 19: 887-897. 2010/04/20. DOI:
17 10.1007/s11136-010-9649-x.
- 18 40. Varni JW, Limbers CA, Burwinkle TM, et al. The ePedsQL in type 1 and type 2 diabetes:
19 feasibility, reliability, and validity of the Pediatric Quality of Life Inventory Internet
20 administration. *Diabetes care* 2008; 31: 672-677. 2008/01/11. DOI: 10.2337/dc07-2021.

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Table 1. Patient profiles at recruitment

	Total (n=566)	Idiopathic scoliosis (n=357)	Limb Conditions (n=209)
Gender (n, %)			
Male	183, 32.3%	70, 19.6%	113, 54.1%
Female	383, 67.7%	287, 80.4%	96, 45.9%
Distribution of patients for PedsQL(n, %)			
Version 8-12 years	227, 40.1%	102, 28.6%	125, 59.8%
Version 13-18 years	339, 59.9%	255, 71.4%	84, 40.2%
Age, year (mean \pm SD)			
8-12 years	10.8 \pm 1.3	11.5 \pm 1.3	10.2 \pm 1.4
13-18 years	14.3 \pm 1.2	14.7 \pm 1.3	14.5 \pm 1.4
Body height, cm (mean \pm SD)			
8-12 years	147.4 \pm 11.0	153.2 \pm 7.8	142.6 \pm 10.9
13-18 years	162.0 \pm 8.3	161.8 \pm 8.3	162.7 \pm 8.5
Body weight, kg (mean \pm SD)			
8-12 years	39.0 \pm 9.4	41.3 \pm 7.2	37.1 \pm 10.5
13-18 years	52.4 \pm 10.7	51.5 \pm 10.4	55.2 \pm 11.3
BMI, kg/m ² (mean \pm SD)			
8-12 years	17.8 \pm 3.0	17.5 \pm 2.3	18.0 \pm 3.5
13-18 years	19.9 \pm 3.2	19.6 \pm 3.1	20.8 \pm 3.5
Curve magnitude, Cobb angle, degrees (mean \pm SD, Range)			
<i>Major curve</i>			
Overall		26.1 \pm 8.4, 10.6 to 55.0	
8-12 years		26.0 \pm 8.1, 11.0 to 55.0	
13-18 years		26.2 \pm 8.6, 10.6 to 55.0	
<i>Minor curve</i>			
Overall		20.8 \pm 7.4, 6.7 to 48.0	
8-12 years		21.2 \pm 6.4, 9.4 to 40.0	
13-18 years		20.7 \pm 7.8, 6.7 to 48.0	
Diagnosis (n, %)			
Idiopathic Scoliosis			
Juvenile		14, 3.9%	
Adolescent		343, 96.1%	
Limb pathology			
Musculoskeletal fractures, sprains, dislocation, subluxation			91, 43.5%
Flat feet +/- leg length discrepancy			57, 27.3%
Intoeing gait			10, 4.8%
Pain at foot/ knee/ hip +/- muscle tightness			10, 4.8%
Hallux valgus			6, 2.9%

Hemihypertrophy/ hemiatrophy	6, 2.9%
Developmental issues/skeletal disease/syndromes	5, 2.4%
Achilles tendonitis	4, 1.9%
Exostosis	4, 1.9%
Fibrous dysplasia	2, 1.0%
Others	14, 6.7%

Note: n: number, %: percentage, PedsQL: Pediatric Quality of Life Inventory, cm: centimeter, kg: kilogram, m: meter, +/-: with/ without

Table 2. Comparison of functioning scale and summary scores of PedsQL between pediatric patients with idiopathic scoliosis and limb pathology

PedsQL	Idiopathic Scoliosis					Limb pathology					P-value^ for mean scores
	n=105					n=124					
Children 8-12	Median	Mean	SD	% floor	% ceiling	Median	Mean	SD	% floor	% ceiling	
Physical	96.9	92.7	10.8	0%	41.0%	84.4	81.7	17.7	0%	21.0%	<0.001*
Emotional	95.0	88.0	15.0	0%	41.9%	80.0	79.1	17.2	0%	21.0%	<0.001*
Social	100.0	94.8	10.3	0%	65.7%	95.0	89.5	14.2	0%	44.4%	0.001*
School	90.0	85.9	12.9	0%	18.1%	85.0	81.6	15.2	0%	17.7%	0.02*
Psychosocial Health Summary Score	93.3	89.5	10.6	0%	13.3%	85.8	83.4	12.8	0%	6.5%	<0.001*
Physical Health Summary Score	96.9	92.7	10.8	0%	41.0%	84.4	81.7	17.7	0%	21.0%	<0.001*
Total Score	94.6	90.6	9.6	0%	10.5%	85.9	82.8	12.5	0%	4.8%	<0.001*
Children 13-18	n=252					n=85					
Physical	96.9	90.0	13.0	0%	37.3%	87.5	85.0	14.2	0%	14.1%	0.003*
Emotional	90.0	84.4	15.6	0%	31.8%	80.0	79.5	15.3	0%	18.8%	0.01*
Social	100.0	92.2	12.9	0%	60.3%	95.0	90.8	10.7	0%	42.4%	0.31
School	85.0	82.9	14.5	0%	17.5%	75.0	77.3	13.9	0%	8.2%	0.002*
Psychosocial Health Summary Score	90.0	86.5	11.8	0%	9.9%	81.7	82.5	11.1	0%	5.9%	0.006*
Physical Health Summary Score	96.9	90.0	13.0	0%	37.3%	87.5	85.0	14.2	0%	14.1%	0.003*
Total Score	90.2	87.7	10.9	0%	8.7%	83.7	83.4	10.3	0%	4.7%	0.001*

^ Any significant difference of mean values tested by independent *t*-test

Note: n: number, %: percentage, PedsQL: Pediatric Quality of Life Inventory

Table 3. Frequency distribution (count and percentage) of youth version of 5-level EuroQol-5-dimension

EQ-5D-5L-Y	Idiopathic scoliosis					Limb pathology					P-value^	Idiopathic scoliosis		Limb pathology		
	Response level (Count)					Response level (Count)						% Ceiling	% Floor	% Ceiling	% Floor	
	1	2	3	4	5	1	2	3	4	5						
Mobility	332	24	1	0	0	156	45	6	2	0	<0.001*	0.0	93.0	0.0	74.6	
Looking after myself	347	8	2	0	0	177	22	8	2	0	<0.001*	0.0	97.2	0.0	84.7	
Doing usual activities	324	30	3	0	0	158	40	9	2	0	<0.001*	0.0	90.8	0.0	75.6	
Having pain or discomfort	259	86	11	1	0	128	59	21	1	0	0.002*	0.0	72.6	0.0	61.2	
Feeling worried, sad or unhappy	269	80	7	1	0	142	58	7	1	1	0.25	0.0	75.4	0.5	67.9	
	Median	Mean	SD			Median	Mean	SD			P-value					
EQ-VAS	90	85.7	13.5			90	84.3	13.7			0.22	0%	16.6	0.0	10.6	

EQ-5D-5L-Y	Response level (Percentage)					Response level (Percentage)				
	1	2	3	4	5	1	2	3	4	5
Mobility	93.0	6.7	0.3	0.0	0.0	74.6	21.5	2.9	1.0	0.0
Looking after myself	97.2	2.2	0.6	0.0	0.0	84.7	10.5	3.8	1.0	0.0
Doing usual activities	90.8	8.4	0.8	0.0	0.0	75.6	19.1	4.3	1.0	0.0
Having pain or discomfort	72.5	24.1	3.1	0.3	0.0	61.2	28.2	10.0	0.5	0.0
Feeling worried, sad or unhappy	75.4	22.4	2.0	0.3	0.0	67.9	27.8	3.3	0.5	0.5

^ Any significant differences tested by Chi-squared test or independent t-test, where appropriate

Note: n: number, %: percentage, VAS: Visual analog scale, SD: standard deviation

Table 4. Descriptive statistics of Refined Scoliosis Research Society 22-item (SRS-22r) for scoliosis patients

SRS-22r	n	Idiopathic Scoliosis				
		Median	Mean	SD	% floor	% ceiling
Function	233	4.00	4.00	0.64	0%	9.9%
Self-image	233	4.80	4.72	0.37	0%	49.8%
Pain	233	5.00	4.77	0.37	0%	59.7%
Mental Health	233	4.40	4.35	0.66	0%	28.3%
Satisfaction with Treatment*	76	4.00	3.93	0.78	0%	13.2%
Total	233	4.55	4.45	0.41	0%	4.3%

* Patients can opt to leave this domain items unanswered

Note: n: number, SD: standard deviation, %: percentage

Table 5. Sensitivity of PedsQL based on its functioning scale and summary scores against the youth version of 5-level EuroQol-5-dimension responses

Idiopathic Scoliosis															
EQ-dimension															
EQ-5D-5L-Y Response Level															
PedsQL	Mobility			Looking after myself			Doing usual activities			Having pain or discomfort			Feeling worried, sad or unhappy		
	1	2-5	P-value	1	2-5	P-value	1	2-5	P-value	1	2-5	P-value	1	2-5	P-value
Children 8-12	Mean	Mean	P-value	Mean	Mean	P-value	Mean	Mean	P-value	Mean	Mean	P-value	Mean	Mean	P-value
Physical	93.6	82.0	0.003*	93.8	77.2	0.03*	94.1	79.4	<0.001*	94.7	83.9	<0.001*	93.5	90.0	0.17
Emotional	88.4	82.5	0.29	88.1	86.4	0.78	88.2	86.0	0.67	89.8	80.3	0.01*	90.6	79.0	<0.001*
Social	95.5	85.6	0.13	95.2	88.6	0.10	95.3	89.5	0.09	95.9	90.0	0.07	96.9	87.7	0.005*
School	86.3	80.6	0.23	86.4	78.6	0.12	86.6	79.0	0.08	87.2	80.0	0.02*	87.7	79.8	0.008*
Psychosocial Health															
Summary Score	90.1	82.9	0.07	89.9	84.5	0.20	90.0	84.8	0.14	91.0	83.4	0.004*	91.7	82.2	<0.001*
Physical Health															
Summary Score	93.6	82.0	0.003*	93.8	77.2	0.03*	94.1	79.4	<0.001*	94.7	83.9	<0.001*	93.5	90.0	0.17
Total Score	91.3	82.6	0.01*	91.2	82.0	0.01*	91.4	82.9	0.007*	92.3	83.6	<0.001*	92.3	84.9	<0.001*
Children 13-18															
Physical	91.6	68.4	<0.001*	90.2	74.0	0.03*	92.0	69.8	<0.001*	93.4	82.4	<0.001*	92.3	83.2	<0.001*
Emotional	85.6	69.1	<0.001*	84.5	80.0	0.62	84.6	82.8	0.60	86.5	79.9	0.002*	88.5	72.4	<0.001*
Social	93.1	80.3	0.01*	92.3	85.0	0.33	92.8	87.0	0.12	93.2	90.1	0.09	94.8	84.8	<0.001*
School	83.8	70.6	<0.001*	83.0	76.7	0.45	83.5	76.5	0.03*	85.0	78.1	<0.001*	85.6	74.8	<0.001*
Psychosocial Health															
Summary Score	87.5	73.3	0.002*	86.6	80.6	0.38	87.0	82.1	0.06	88.2	82.7	<0.001*	89.6	77.3	<0.001*
Physical Health															
Summary Score	91.6	68.4	<0.001*	90.2	74.0	0.03*	92.0	69.8	<0.001*	93.4	82.4	<0.001*	92.3	83.2	<0.001*
Total Score	89.0	71.6	<0.001*	87.8	78.3	0.13	88.7	77.8	<0.001*	90.0	82.6	<0.001*	90.6	79.4	<0.001*

Limb Pathology															
EQ-dimension															
Mobility			Looking after myself			Doing usual activities			Having pain or discomfort			Feeling worried, sad or unhappy			
EQ-5D-5L-Y Response Level															
PedsQL	1		P-value	2-5		P-value	1		P-value	2-5		P-value	1		P-value
	Mean	Mean		Mean	Mean		Mean	Mean		Mean	Mean		Mean		
Children 8-12															
Physical	85.8	70.5	<0.001*	85.2	64.7	<0.001*	87.8	64.9	<0.001*	88.5	69.7	<0.001*	86.0	72.4	<0.001*
Emotional	81.0	73.8	0.04*	80.2	73.6	0.11	81.3	73.0	0.04*	82.0	74.0	0.01*	84.9	66.4	<0.001*
Social	90.9	85.6	0.07	90.6	84.0	0.06	91.5	83.8	0.02*	90.8	87.2	0.18	92.6	82.7	0.001*
School	82.7	78.3	0.15	83.1	74.0	0.01*	83.0	77.6	0.08	83.4	78.4	0.08	84.2	75.8	0.004*
Psychosocial Health															
Summary Score	84.9	79.2	0.03*	84.6	77.2	0.01*	85.3	78.1	0.02*	85.4	79.9	0.02*	87.3	75.0	<0.001*
Physical Health															
Summary Score	85.8	70.5	<0.001*	85.2	64.7	<0.001*	87.8	64.9	<0.001*	88.5	69.7	<0.001*	86.0	72.4	<0.001*
Total Score	85.2	76.2	<0.001*	84.8	72.9	<0.001*	86.2	73.5	<0.001*	86.5	76.4	<0.001*	86.8	74.1	<0.001*
Children 13-18															
Physical	87.7	76.1	0.02*	88.1	64.5	0.006*	88.3	72.6	0.003*	88.5	80.2	0.007*	84.2	86.7	0.34
Emotional	80.1	77.5	0.51	79.2	81.4	0.66	78.7	82.2	0.39	80.4	78.2	0.51	80.5	77.3	0.37
Social	91.7	87.8	0.15	91.0	89.1	0.58	91.3	88.6	0.34	90.0	91.8	0.45	91.6	89.1	0.32
School	78.1	74.8	0.35	77.6	75.5	0.64	77.6	76.1	0.69	77.4	77.1	0.91	77.0	77.9	0.80
Psychosocial Health															
Summary Score	83.3	80.0	0.25	82.6	82.0	0.86	82.6	82.3	0.93	82.6	82.4	0.92	83.0	81.4	0.53
Physical Health															
Summary Score	87.7	76.1	0.02*	88.0	64.5	0.006*	88.3	72.6	0.003*	88.5	80.2	0.007*	84.2	86.7	0.34
Total Score	84.8	78.6	0.07	84.5	75.9	0.009*	84.6	78.9	0.04*	84.7	81.6	0.18	83.4	83.3	0.95

Note: P-values of any significant difference of scores between patients with no problem (EQ-5D-5L-Y response level 1) versus mild-severe problems (EQ-5D-5L-Y response level 2-5) using independent t-test, PedsQL: Pediatric Quality of Life Inventory, EQ-5D-5L-Y: Youth version of 5-level EuroQol-5-dimension

Table 6. Correlation tests between PedsQL and SRS-22r scores and association tests between curve magnitude and SRS-22r scores

Idiopathic Scoliosis						
PedsQL	SRS-22r					
	Function	Self-image	Pain	Mental Health	Satisfaction with Treatment	Total
Children 8-12	Spearman's correlation coefficients					
Physical	0.23	0.22	0.15	0.25*	-0.06	0.26*
Emotional	0.14	0.12	0.01	0.09	0.04	0.11
Social	0.29*	0.22	0.20	0.23	-0.08	0.27*
School	0.29*	0.18	0.08	0.14	-0.07	0.24*
Psychosocial Health Summary Score	0.30*	0.23	0.16	0.19	-0.03	0.28*
Physical Health Summary Score	0.23	0.22	0.15	0.25*	-0.06	0.26*
Total Score	0.31**	0.24*	0.19	0.21	-0.05	0.29*
Children 13-18	Spearman's correlation coefficients					
Physical	0.20*	0.42**	0.33**	0.24**	-0.18*	0.34**
Emotional	0.18*	0.18*	0.20*	0.37**	-0.06	0.32**
Social	0.21**	0.27**	0.26**	0.28*	-0.09	0.32**
School	0.21**	0.24**	0.28**	0.19*	-0.05	0.28**
Psychosocial Health Summary Score	0.23**	0.24**	0.26**	0.31**	-0.07	0.34**
Physical Health Summary Score	0.20*	0.42**	0.33**	0.24**	-0.18*	0.34**
Total Score	0.24**	0.31**	0.31**	0.32**	-0.12	0.37**
Curve magnitude and curve types						
	Function	Self-image	Pain	Mental Health	Satisfaction with Treatment	Total
Children 8-12	Spearman's correlation coefficients					
Major coronal Cobb angle	0.28*	0.00	-0.13	0.05	0.33	-0.03
Minor coronal Cobb angle	0.39*	0.06	0.15	0.02	0.41	0.13
	Kruskal-Wallis - H statistics					
Curve types	0.18	0.81	0.87	1.52	2.54	0.22
	Eta squared (η^2)					
(T, TL/L, double curves)	0.03	0.02	0.02	0.01	0.01	0.03
Children 13-18	Spearman's correlation coefficients					
Major coronal Cobb angle	0.08	-0.16*	0.02	0.07	0.26	0.01
Minor coronal Cobb angle	0.05	-0.20*	0.01	-0.01	0.09	-0.06
	Kruskal-Wallis - H statistics					
Curve types	0.80	0.21	3.19	2.88	2.02	3.39
	Eta squared (η^2)					
(T, TL/L, double curves)	0.02	0.03	0.02	0.01	0.00	0.02

* p < 0.05, ** p < 0.01

Note: PedsQL: Pediatric Quality of Life Inventory, SRS-22r: Refined Scoliosis Research Society 22-item, T: thoracic, TL: thoracolumbar, L: lumbar

Appendix. Frequency distribution of PedsQL 4.0 Generic Core Scales responses

PedsQL	n	Idiopathic Scoliosis					n	Limb pathology				
		0 (never)	1	2	3	4 (almost always)		0 (never)	1	2	3	4 (almost always)
Children 8-12												
Physical												
item 1	105	88	16	1	0	0	124	78	31	13	1	1
item 2	105	72	27	3	2	1	124	56	33	17	15	3
item 3	105	79	21	3	1	1	124	59	32	17	11	5
item 4	105	75	21	8	1	0	124	64	31	19	5	5
item 5	105	99	3	1	0	2	124	104	9	5	5	1
item 6	105	94	8	1	1	1	124	92	14	8	8	2
item 7	105	76	17	11	0	1	124	59	29	24	9	3
item 8	105	74	25	5	1	0	124	59	42	16	3	4
Emotional												
item 1	105	72	24	8	1	0	124	58	43	14	6	3
item 2	105	65	33	6	0	1	124	57	46	17	4	0
item 3	105	67	28	7	2	1	124	50	40	28	5	1
item 4	105	73	23	6	2	1	124	55	40	21	4	4
item 5	105	61	30	10	2	2	124	66	28	22	4	4
Social												
item 1	105	85	13	6	0	1	124	86	29	7	2	0
item 2	105	88	14	3	0	0	124	89	25	7	2	1
item 3	105	91	13	1	0	0	124	86	21	14	0	3
item 4	105	84	16	4	0	1	124	85	31	7	1	0
item 5	105	90	12	3	0	0	124	92	19	7	3	3
School												
item 1	105	80	17	8	0	0	124	71	37	11	4	1
item 2	105	55	27	19	4	0	124	55	43	20	5	1
item 3	105	79	18	5	2	1	124	82	27	10	3	2
item 4	105	70	27	6	0	2	124	63	45	12	3	1
item 5	105	31	48	24	2	0	124	35	57	24	3	5
Children 13-18												
Physical												
item 1	252	200	40	12	0	0	85	65	15	5	0	0
item 2	252	165	43	27	13	4	85	41	28	11	2	3
item 3	252	164	52	22	11	3	85	48	23	9	1	4
item 4	252	168	54	22	7	1	85	52	24	5	1	3
item 5	252	245	4	2	1	0	85	75	2	4	2	2

item 6	252	217	27	7	1	0	85	68	10	7	0	0
item 7	252	153	65	29	4	1	85	29	27	20	8	1
item 8	252	163	55	26	6	2	85	38	34	10	3	0
Emotional												
item 1	252	140	81	30	1	0	85	38	35	8	4	0
item 2	252	132	84	32	4	0	85	38	30	16	1	0
item 3	252	140	77	33	1	1	85	37	32	13	2	1
item 4	252	145	73	26	8	0	85	41	28	11	4	1
item 5	252	126	77	45	2	2	85	27	34	20	3	1
Social												
item 1	252	181	51	15	5	0	85	60	20	5	0	0
item 2	252	198	36	13	5	0	85	60	23	2	0	0
item 3	252	194	49	8	1	0	85	54	24	6	0	1
item 4	252	193	44	14	1	0	85	59	21	4	1	0
item 5	252	190	49	12	1	0	85	61	21	2	1	0
School												
item 1	252	138	74	31	8	1	85	34	31	15	5	0
item 2	252	104	79	47	20	2	85	32	33	13	6	1
item 3	252	148	87	14	3	0	85	48	27	7	3	0
item 4	252	161	72	18	1	0	85	28	42	14	1	0
item 5	252	90	106	52	4	0	85	12	44	26	2	1

Note: n: number, %: percentage, PedsQL: Pediatric Quality of Life Inventory