

HEALTH SERVICES RESEARCH

The Scoliosis Research Society Health-Related Quality Of Life (SRS-30) Age–Gender Normative Data

An Analysis of 1346 Adult Subjects Unaffected by Scoliosis

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Study Design. Prospective, cross-sectional study.**Objective.** To determine Scoliosis Research Society (SRS)-30 health-related quality of life (HRQOL) reference values by age and gender in an adult population unaffected by scoliosis thereby allowing clinicians and investigators to compare individual and/or groups of spinal deformity patients to their generational peers.**Summary of Background Data.** Normative data are collected to establish means and standard deviations of health-related quality of life outcomes representative of a population. The SRS HRQOL questionnaire has become the standard for determining and comparing treatment outcomes in spinal deformity practices. With the establishment of adult SRS-30 HRQOL population values, clinicians, and investigators now have a reference for interpretation of individual scores and/or the scores of subgroups of adult patients with spinal deformities.**Methods.** The SRS-30 HRQOL was issued prospectively to 1346 adult volunteers recruited from across the United States. Volunteers self-reported no history of scoliosis or prior spine surgery. Domain medians, means, confidence intervals, percentiles, and minimum/maximum values were calculated for six generational age–gender groups: male/female; 20–39, 40–59, and 60–80 years of age.**Results.** Median and mean domain values ranged from 4.1 to 4.6 for all age–gender groups. The older the age–gender group, the lower (worse) the reported domain median and mean scores. The only exception was the mental health domain scores in the female groups which improved slightly. Males reported higher (better) scores than females but only the younger males were significantly higher in all domains than their female counterparts. In addition, all male groups reported higher Mental Health domain scores than their female counterparts ($P = 0.003$).**Conclusion.** This study reports population medians, means, standard deviations, percentiles, and confidence intervals for the domains of the SRS-30 HRQOL instrument. Clinicians must be mindful of age–gender differences when assessing deformity populations. Generational decreases noted in the older adult volunteer scores may provide a basis for future investigators to interpret observed score decreases in patient cohorts at long-term follow-up.**Key words:** adult deformity, volunteers, normative values.**Spine 2011;36:1154–1162**

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Patient-reported health-related quality of life (HRQOL) outcome questionnaires have gained popularity as the method to objectively assess baseline pathology and to measure the effectiveness of an intervention. The researcher's challenge is to select a tool that is sensitive, specific, and reliable, capturing the unique characteristics of the disease and individual of interest.

Haher initiated the development of a disease-specific HRQOL instrument to measure the many facets of spinal deformity. The original questionnaire consisted of 24 items divided into seven domains (SRS-24).¹ In 2000, Asher *et al* modified the instrument to address shortcomings.² Similar domains were merged, a new domain (mental health) was added and the historical recall questions were eliminated. The result was a 23-item questionnaire [modified SRS (MSRS) or SRS-23] with five domains (pain, self-image, function/activity, mental health, and satisfaction). In 2003, question 4 was rephrased, moved from the pain to self-image domain, and seven historical recall questions were added resulting in this day

version, the SRS-30.³ In 2006, Asher *et al* further refined the tool to address diminished internal consistency (Cronbach's alpha) for the Function domain in adolescent idiopathic scoliosis patients.⁴ After a minor revision to question 18, internal consistency improved for adolescents without loss of internal consistency for the adult population.⁴ A copy of the various versions, scoring instructions, and a detailed bibliography of the development of the SRS-HRQOL can be found on the Scoliosis Research Society Web site: www.srs.org.

There have been a number of efforts to validate the SRS HRQOL questionnaire in adolescent deformity populations.^{1,2,4-9} More recent efforts confirm the tool's psychometric qualities (concurrent and discriminate validity, internal consistency, reliability over time, and sensitivity to change) in adult deformity patients.¹⁰⁻¹³

Normative data are collected to establish mean and standard deviations of HRQOL outcomes representative of a population. The purpose of this study was to establish age–gender values for the SRS-30 HRQOL outcomes tool in an adult population with no history of spinal deformity or spinal surgery. We hypothesized self-reported scores associated with pain, activity, self-image, and mental health would be lower in older volunteers but there would be no differences in scores by gender. With the establishment of adult SRS-30 HRQOL population values, clinicians and investigators will now have a reference for the interpretation of scores reported by an individual and/or subgroups of adults with spinal deformities.

MATERIALS AND METHODS

The SRS-30 HRQOL questionnaire was prospectively collected from 1346 adult volunteers (582 males, 764 females) between January 2004 and December 2007. The volunteers were sampled from 10 spine centers located in eight states in the United States (AL, CO, IL, KY, MD, MO, NY, and VA). Volunteers were family (primarily spouses or significant others), friends, or acquaintances accompanying patients with spinal problems to the spine treatment center. Similarly, spine center employees solicited volunteers through networking systems of coworkers, family, and friends. Volunteers were also recruited through university registries, Web sites, and health fairs. To be included in the analysis, volunteers self-reported no prior history of scoliosis as well as no prior history of spine surgery. No patient seeking treatment at the 10 centers was recruited or included in this analysis.

Previous publications suggest symptoms associated with scoliosis change according to generational age groups.¹²⁻¹⁵ Younger adults have few, if any degenerative changes; middle-aged adults begin developing symptomatic degenerative changes; and older adults have increasing degenerative and comorbid conditions. Therefore, volunteers were stratified into six generational age–gender groups for analysis: male/female; 20–39, 40–59, and 60–80 years of age. There were 203 females and 181 males 20 to 39 years of age, 299 females and 201 males between the ages of 40 and 59 years, and 262 females and 200 males in the 60 to 80 year age group.

Questionnaires were self-administered with pen and paper. Domain medians, means, standard deviations, 95% confi-

dence intervals, and percentiles were calculated for each of the six age–gender groups. A common practice is to report the “Total” score, a mean score averaged across all domains, including two satisfaction questions. We excluded the satisfaction questions from our analysis because the volunteers were not receiving spinal treatment. Therefore, we reported a “Subscore” in our results, which is the total score less the two satisfaction questions. It should also be noted the seven historical recall questions were also excluded from analysis for the same reason (no interventions received by volunteers).

Statistical analysis was performed by ANOVA for each of the scales for males and then for females, the age category being the grouping. This was followed by *post hoc* testing using and Tukey's Least Significant Difference to determine if differences between any two of the three age groups were statistically significant. Independent samples *t* test were performed to compare genders in each age group. Significance was set at *P* value of 0.01 for all tests.

RESULTS

Descriptive statistics for each domain by age–gender group are shown in Table 1. Except for the mental health domain, lower domain scores were reported with advancing age–gender group analysis. The highest (best) domain scores were reported by the youngest male group (20–39 years). The lowest (worst) domain scores were reported by the oldest female group (60–80 years) except for the mental health domain where the youngest females (20–39 years) reported the lowest scores. Pain domain median scores ranged from 4.4 to 4.6. Self-image median scores ranged from 4.3 to 4.6. Function median scores ranged from 4.2 to 4.6. Mental health median scores ranged from 4.1 to 4.4. Subtotal median values ranged from 4.3 to 4.5.

Overall, male domain scores were higher (better) than those reported by the female volunteers but only the younger male group (20–39 years) scored significantly higher than their female counterparts in all four domains ($P \leq 0.001$; Table 2). The mean differences reported between the youngest male/female groups domain scores were: pain, 0.17; self image, 0.24; function, 0.13; mental health, 0.27; and subscore, 0.2. All three male age groups reported significantly higher (better) mental health domain scores than the female groups ($P \leq 0.003$). The mean differences between the age gender group's mental health scores (youngest, middle, and older) were 0.27, 0.14, and 0.19, respectively.

Table 3 provides SRS domain scores corresponding to a given percentile for each age gender group. These scores represent the score for the population at or below a given percentage. The clinician who has calculated a domain score for an adult patient can use this table to interpret that individual's score. Figures 1 to 5 are graphical representations of the data for each age–gender group (box plots). Heavy lines through the boxes represent median scores. The two ends of the rectangles represent the upper and the lower quartiles. The lines or “whiskers” extending from each rectangle represent the minimum and maximum values. Points outside the whiskers are identified as Outliers (o) if they are between 1.5 and

TABLE 1. SRS-30 HRQOL Descriptive Statistics by Domain for Age-Gender Group

	Age Group (yr)	n	Mean	SD	Median	95% CI	Min	Max
Pain domain								
Males	20-39	181	4.57	0.46	4.6	0.07	1.6	5.0
	40-59	201	4.40	0.65	4.6	0.09	1.8	5.0
	60-80	200	4.40	0.66	4.6	0.09	1.5	5.0
Females	20-39	203	4.40	0.59	4.6	0.08	2.0	5.0
	40-59	299	4.33	0.63	4.4	0.07	2.0	5.0
	60-80	262	4.23	0.79	4.4	0.10	1.0	5.0
Self image/appearance								
Males	20-39	181	4.46	0.46	4.6	0.07	3.0	5.0
	40-59	201	4.25	0.56	4.4	0.08	1.8	5.0
	60-80	200	4.27	0.53	4.3	0.08	1.3	5.0
Females	20-39	203	4.22	0.53	4.3	0.07	2.4	5.0
	40-59	299	4.16	0.59	4.3	0.07	1.7	5.0
	60-80	262	4.16	0.65	4.3	0.08	1.1	5.0
Function								
Males	20-39	181	4.44	0.31	4.6	0.05	3.0	5.0
	40-59	201	4.29	0.48	4.4	0.07	1.8	5.0
	60-80	200	4.18	0.53	4.4	0.07	1.4	5.0
Females	20-39	203	4.30	0.42	4.4	0.06	1.2	5.0
	40-59	299	4.30	0.42	4.4	0.05	2.0	5.0
	60-80	262	4.11	0.60	4.2	0.07	1.4	5.0
Mental Health								
Males	20-39	181	4.33	0.46	4.4	0.07	2.6	5.0
	40-59	201	4.22	0.50	4.3	0.07	2.2	5.0
	60-80	200	4.28	0.50	4.3	0.07	1.2	5.0
Females	20-39	203	4.06	0.47	4.1	0.07	2.6	5.0
	40-59	299	4.08	0.55	4.2	0.06	1.5	5.0
	60-80	262	4.09	0.57	4.2	0.07	1.3	5.0
Subscore								
Males	20-39	181	4.43	0.35	4.5	0.05	3.0	5.0
	40-59	201	4.27	0.47	4.4	0.07	2.0	5.0
	60-80	200	4.28	0.46	4.3	0.06	1.4	5.0
Females	20-39	203	4.21	0.41	4.3	0.06	2.7	5.0
	40-59	299	4.19	0.47	4.3	0.05	1.8	5.0
	60-80	262	4.14	0.56	4.3	0.07	1.4	5.0

Kolmogorov-Smirnov (KS) statistic for each age-gender group was highly significant in all domains (P < 0.001), confirming the data are not normally distributed.

three box lengths from the edge of the box. They are identified as extreme outliers (*) if they are more than three box lengths away.

It can be seen from the percentiles and the box plots that the volunteer scores were skewed toward better health. The Kolmogorov-Smirnov (KS) statistic for each age-gender

TABLE 2. Statistical Comparison of Gender Domain Means (Independent Samples *t* Test) by Age Group

Age–Gender Comparison			Young (20–39 years)			Middle (40–59 years)			Older (60–80 years)		
Domain	Gender	N	Mean	SD	<i>P</i>	Mean	SD	<i>P</i>	Mean	SD	<i>P</i>
Pain	M	181	4.57	0.46	0.001	4.40	0.65	0.292	4.40	0.66	0.015
	F	203	4.40	0.59		4.33	0.63		4.23	0.79	
Self image	M	181	4.46	0.46	<0.001	4.25	0.56	0.081	4.27	0.53	0.059
	F	203	4.22	0.53		4.16	0.59		4.16	0.65	
Function	M	181	4.44	0.31	<0.001	4.29	0.48	0.928	4.18	0.53	0.169
	F	203	4.30	0.42		4.30	0.42		4.11	0.60	
Mental health	M	181	4.33	0.46	<0.001	4.22	0.50	0.003	4.28	0.50	<0.001
	F	203	4.06	0.47		4.08	0.55		4.09	0.57	
Subscore	M	181	4.43	0.35	<0.001	4.27	0.47	0.043	4.28	0.46	0.004
	F	203	4.21	0.41		4.19	0.47		4.14	0.56	

P values represent differences in domain scores between males and females by age group.

group is highly significant in all domains ($P < 0.001$), confirming the data are not normally distributed. (Table 1).

DISCUSSION

This study establishes adult population domain and subscore medians, means, standard deviations, and percentiles for the SRS-30 HRQOL instrument. Ninety-five percent confidence intervals around these means are reported.

There are a growing number of HRQOL measures used to evaluate clinical outcomes. The trends seen in our analysis are similar to normative data reported for other instruments.

The Short Form 36 (SF-36) is a widely used measure of HRQOL capturing eight domains: physical functioning, role physical, bodily pain, general health perception, energy/vitality, social functioning, role emotional, and mental health. The physical functioning domain has been shown to be the best measure of physical health, whereas the mental health domain is the most valid measure of mental health.¹⁶ The SF-36 normative data reported for the United States,¹⁶ Canada,¹⁷ and the United Kingdom^{18,19} were similar to our SRS-30 HRQOL results in that the physical functioning domain mean scores were lower in the older age groups. For scale comparisons, only the youngest and oldest age gender groups for which all three countries have reported normative SF-36 values are presented here (25–34 and 55–64 years of age, respectively). The SF-36 physical function normative mean scores for male groups (25–34 vs. 55–64 years of age) were 94.9 versus 79.9 (United States), 94.0 versus 84.7 (Canada), and 93.9 versus 80.0 (UK). Similarly, all the male groups SF-36 physical functioning scores were higher than those reported by their female counterparts: 89.1 versus 73.1 (United States), 90.0 versus 79.9 (Canada), and 92.9 versus 74.8 (UK).

Our male groups reported higher (better) mental health scores than their female counterparts but only the female

groups reported higher scores in the advancing age groups. This differs from the SF-36 normative data, where the highest mental health scores were reported in the oldest SF-36 age groups, regardless of gender. SF-36 mental health normative values for males (25–34 vs. 55–64 years of age) were 74.1 versus 76.9 (United States), 77.7 versus 81.7 (Canada), and 74.8 versus 75.8 (UK). Female age group scores followed suit: 72.5 versus 73.4 (United States), 74.1 versus 77.4 (Canada), and 71.6 versus 74.4 (UK). We cannot account for the lower scores reported by our oldest males (60–80 years), because the five mental health questions from the SRS 30 HRQOL are the same five questions used to score the SF-36 Mental Health domain.

Jenkinson reported females from the UK had statistically poorer health in all domains ($P < 0.001$) except in general health perceptions.¹⁹ Although these observed differences were statistically significant, we are uncertain of the clinical significance of these findings. Ware considered a difference of five points to be clinically and socially significant. By converting the SRS-30 HRQOL domain scale scoring from 1–5 to 0–100, we can identify clinically significant differences, using Ware's five point threshold. Although the youngest males (20–39 years) reported statistically higher scores in all domains than their female counterparts, only the self image, mental health and subscore domains met clinically significant thresholds. The younger males converted self image, mental health and subscore mean domain scores are 86.5 (4.46), 83.25 (4.33), and 85.75 (4.43) versus younger females score of 80.5 (4.22), 76.5 (4.06), and 80.25 (4.21), respectively.

We also found all male groups reported statistically higher mental health domain scores than their female counterparts but only the youngest (20–30 years) and oldest (60–80 years) were significantly statistically significant ($P < 0.002$) and

TABLE 3. Domain Percentiles by Age-Gender Groups

Percentile	Male Age Groups			Female Age Groups		
	20-39	40-59	60-80	20-39	40-59	60-80
Pain						
5	3.8	3.0	3.0	3.4	3.0	2.6
10	4.0	3.4	3.6	3.6	3.4	3.2
20	4.2	4.0	4.0	4.0	3.8	3.6
30	4.4	4.2	4.2	4.2	4.2	4.0
40	4.6	4.4	4.4	4.3	4.2	4.2
50	4.6	4.6	4.6	4.6	4.4	4.4
60	4.8	4.8	4.8	4.6	4.6	4.6
70	5.0	4.9	4.8	4.8	4.8	4.8
80	5.0	5.0	5.0	5.0	5.0	5.0
90	5.0	5.0	5.0	5.0	5.0	5.0
95	5.0	5.0	5.0	5.0	5.0	5.0
Self image						
5	3.5	3.1	3.3	3.3	3.1	2.9
10	3.8	3.5	3.5	3.6	3.4	3.3
20	4.1	3.9	3.9	3.8	3.8	3.6
30	4.3	4.1	4.1	4.0	3.9	3.9
40	4.4	4.2	4.2	4.2	4.1	4.1
50	4.6	4.4	4.3	4.3	4.3	4.3
60	4.7	4.5	4.4	4.4	4.4	4.5
70	4.8	4.6	4.6	4.5	4.5	4.6
80	4.9	4.7	4.7	4.7	4.7	4.7
90	5.0	4.9	4.9	4.9	4.8	4.9
95	5.0	5.0	5.0	5.0	4.9	5.0
Function						
5	3.8	3.2	3.2	3.4	3.4	3.0
10	4.0	3.6	3.4	3.8	3.8	3.2
20	4.2	4.1	3.8	4.0	4.0	3.6
30	4.4	4.2	4.0	4.2	4.2	4.0
40	4.4	4.4	4.2	4.4	4.2	4.0
50	4.6	4.4	4.4	4.4	4.4	4.2
60	4.6	4.6	4.4	4.4	4.4	4.4
70	4.6	4.6	4.6	4.6	4.6	4.5
80	4.6	4.6	4.6	4.6	4.6	4.6
90	4.8	4.6	4.8	4.6	4.6	4.8
95	4.8	4.8	4.8	4.8	4.8	4.8

(Continued)

TABLE 3. (Continued)

Percentile	Male Age Groups			Female Age Groups		
	20-39	40-59	60-80	20-39	40-59	60-80
Mental health						
5	3.4	3.3	3.4	3.1	3.0	3.0
10	3.7	3.5	3.6	3.4	3.4	3.2
20	4.0	3.9	3.9	3.7	3.7	3.6
30	4.2	4.1	4.1	3.9	3.9	3.9
40	4.3	4.2	4.2	4.0	4.1	4.1
50	4.4	4.3	4.3	4.1	4.2	4.2
60	4.5	4.4	4.5	4.2	4.3	4.3
70	4.6	4.5	4.6	4.3	4.4	4.4
80	4.7	4.6	4.7	4.4	4.5	4.5
90	4.9	4.8	4.9	4.7	4.7	4.7
95	4.9	4.9	4.9	4.8	4.9	4.8
Subscore						
5	3.8	3.4	3.3	3.3	3.3	3.0
10	4.0	3.6	3.7	3.7	3.6	3.3
20	4.2	4.0	4.0	3.9	3.9	3.7
30	4.3	4.2	4.1	4.1	4.1	4.0
40	4.4	4.3	4.2	4.2	4.2	4.1
50	4.5	4.4	4.3	4.3	4.3	4.3
60	4.6	4.5	4.5	4.4	4.4	4.4
70	4.7	4.6	4.6	4.5	4.4	4.5
80	4.7	4.6	4.7	4.5	4.6	4.6
90	4.8	4.8	4.8	4.7	4.7	4.7
95	4.9	4.8	4.9	4.8	4.8	4.8

The percentiles are the values below which a certain percent of observations fall. The 20th percentile is the value (or score) below which 20% of the population observations were found.

“clinically” significant. Converted mental health domain scores for the youngest and oldest males are 83.25 (4.33) and 82 (4.28) versus female counterpart respective scores of 76.5 (4.06) and 77.25 (4.09), respectively.

Fryback *et al*²⁰ reported estimated population means by age and gender for six generic HRQOL indexes: EuroQol EQ-5D (EQ-5D), Health Utilities Index Mark 2 (HUI2) and Mark 3 (HUI3), Short Form 6D, Quality of Well-Being Scale Self-Administered form (QWB-SA), and the Health and Activities Limitations index (HA-Lex). They reported all indexes had the same general relationship with age and gender: lower scores reported by older age groups and lower scores reported by females across all age groups.²⁰ These findings are consistent with our stratified age-gender results for the SRS-HRQOL questionnaire.

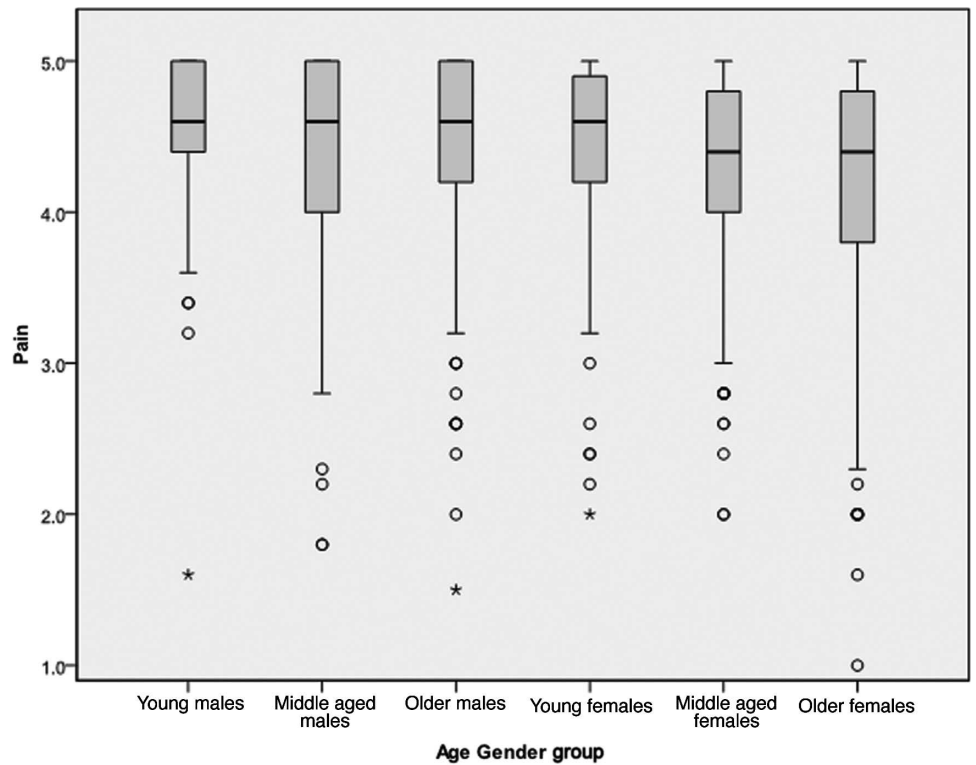


Figure 1. Box plot of pain Scoliosis Research Society (SRS) domain score by age-gender group. Heavy lines through the boxes represent median scores. The two ends of the rectangles represent the upper and the lower quartiles. The lines or “whiskers” extending from each rectangle represent the minimum and maximum values. Outliers are represented with “o” and extreme outliers are represented by “*.”

Selection is always a potential threat to the validity of any study where participants are not randomly chosen.²¹ Ideally, random digit dialing or random computer generated mailings would be used but this was cost-prohibitive for our project. Although we used stratification analysis, which has been suggested as a method to control for selection bias,²² we acknowledge the risk of selection bias may still exist. It should be noted, partici-

pants selected for U.S. SF-36 normative values were based on participation of earlier studies stratified by age and gender (General Social Surveys 1989, 1999).¹⁶ The Canadian SF-36 data¹⁷ were based on a random sample in nine cities designed to provide estimates on the incidence and prevalence of *osteoporosis*.

Sampling bias occurs when study participants are systematically different from the population to whom the results are

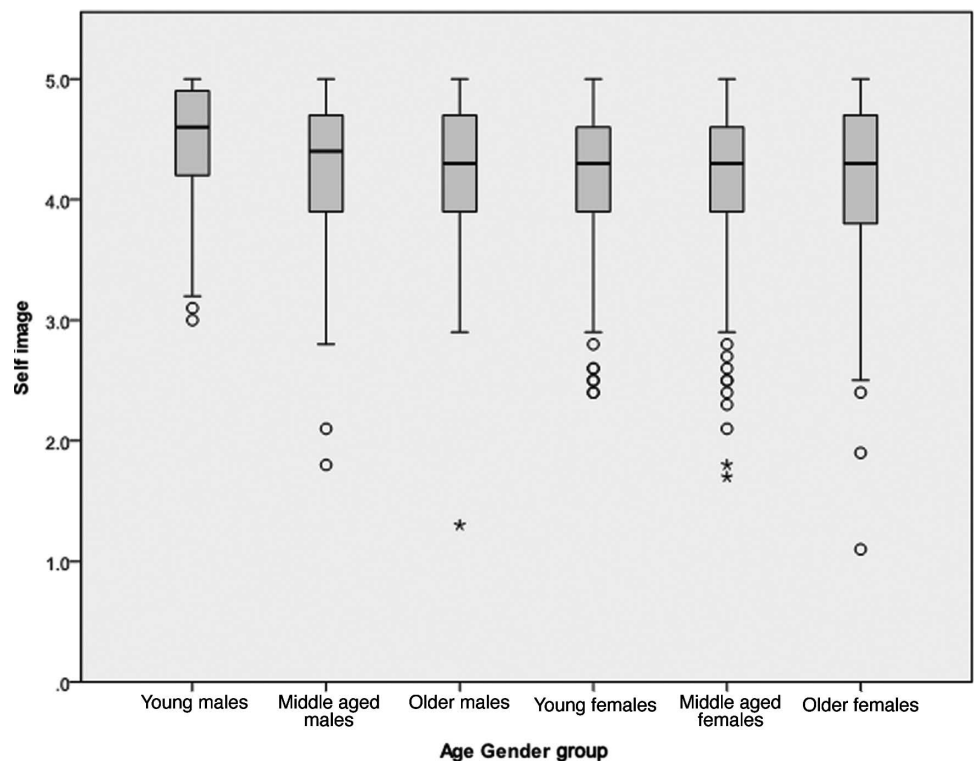


Figure 2. Box plot of Scoliosis Research Society (SRS) self-image domain scores by age-gender group. Heavy lines through the boxes represent median scores. The two ends of the rectangles represent the upper and the lower quartiles. The lines or “whiskers” extending from each rectangle represent the minimum and maximum values. Outliers are represented with “o” and extreme outliers are represented by “*.”

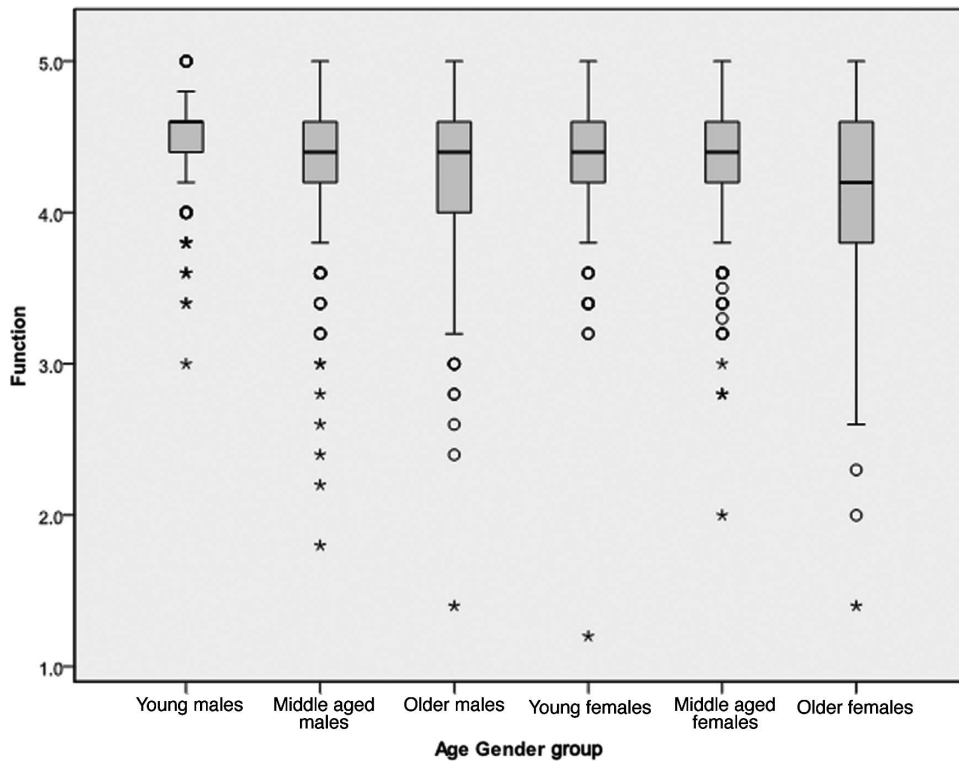


Figure 3. Box plot of Scoliosis Research Society (SRS) function domain scores by age-gender group. Heavy lines through the boxes represent median scores. The two ends of the rectangles represent the upper and the lower quartiles. The lines or “whiskers” extending from each rectangle represent the minimum and maximum values. Outliers are represented with “o” and extreme outliers are represented by “*.”

generalized to. Family and friends of the deformity patients may be more like the patient (people like us), and therefore potentially nonrepresentative of the overall population. Although we do not feel this is likely in our study, there is still a risk of sampling bias. In earlier work, we reported on

the discriminate validity of the SRS-30 HRQOL, comparing a subset of this volunteer population (n = 1222) to primary adult deformity patients (n = 935) using the same age-gender groups. Volunteer scores were significantly higher than the deformity patient scores in all domains ($P < 0.001$)

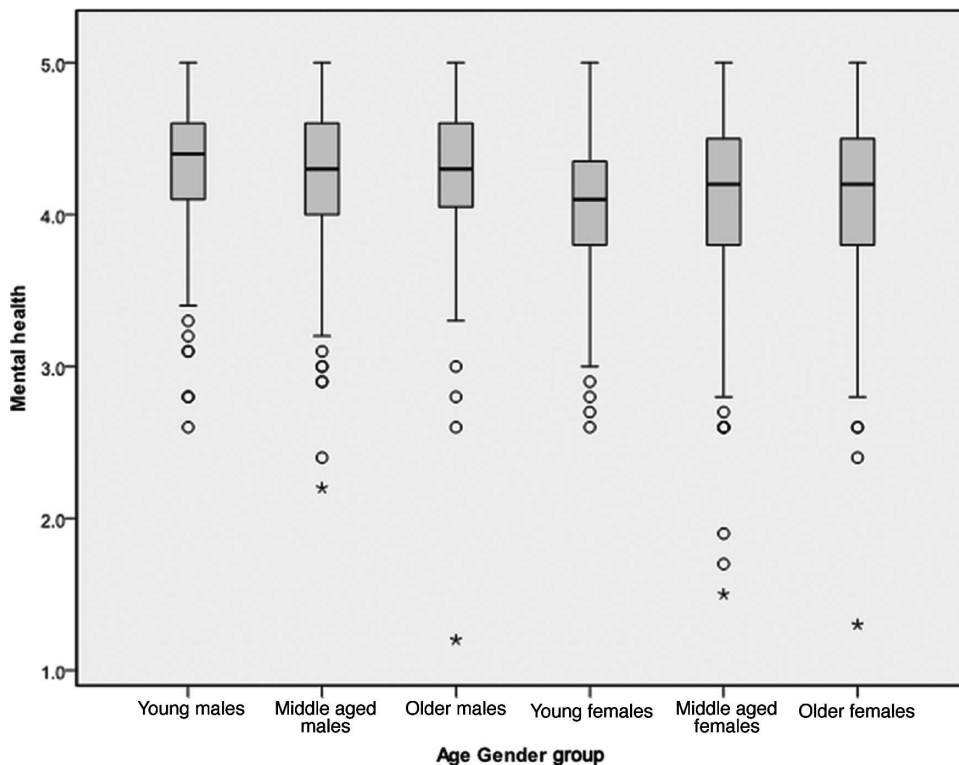


Figure 4. Box plot of Scoliosis Research Society (SRS) mental health domain scores by age-gender group. Heavy lines through the boxes represent median scores. The two ends of the rectangles represent the upper and the lower quartiles. The lines or “whiskers” extending from each rectangle represent the minimum and maximum values. Outliers are represented with “o” and extreme outliers are represented by “*.”

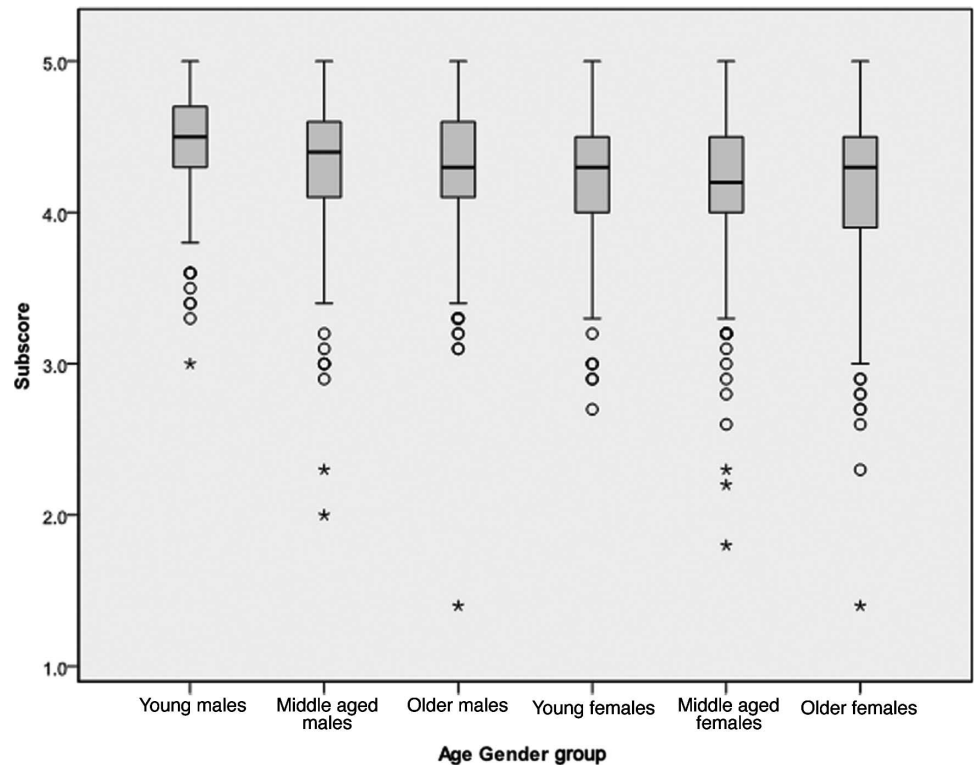


Figure 5. Box plot of Scoliosis Research Society (SRS) subscores by age-gender group. Heavy lines through the boxes represent median scores. The two ends of the rectangles represent the upper and the lower quartiles. The lines or “whiskers” extending from each rectangle represent the minimum and maximum values. Outliers are represented with “o” and extreme outliers are represented by “*.”

except the mental health domain in the older male group (60–80 years).

The Oxford Health and Lifestyle Survey, from which the UK normative data were obtained, limited their random mailings to only four of 40 counties in the UK.¹⁸ The Canadian SF-36 norms¹⁷ were limited to random samples of residents within a 50 km radius of nine Canadian cities. Although we did not collect state of residence data on the volunteer population, a strength of our study is the geographic variety represented. The 10 sites participating in this study are reputable, well-established spinal deformity treatment centers located in eight different states, treating patients from across the country. Therefore, it is likely the volunteers who were family and friends of deformity patients, also lived beyond the immediate treatment center area. The participating spine centers are also members of the Spinal Deformity Study Group (SDSG), actively enrolling patients into a prospective database. We queried the database to confirm the wide geographic representation of centers based on the deformity patient’s state of residence. Information was available for 1113 (82%) of patients enrolled by the 10 centers. We compared the percentage of deformity patients enrolled per state to the U.S. 2006 census population.²³ Six states were overrepresented in the SDSG database based on U.S. population percentages: MO by 16.3%, IL by 7.6%, GA by 7.1%, VA by 6.7%, CO by 6.7%, and KY by 5.4%. This was anticipated as these six states represent eight of the participating centers. Two states were underrepresented in the SDSG database based on U.S. population percentages: CA by 11.4% and TX by 6.3%. For all other states and the District of Columbia ($n = 43$), the SDSG database was $\pm 3.8\%$ of 2006 U.S. population statistics.

It can be seen from the percentile points and box plot figures for each domain age-gender group, that data are not normally distributed, but skewed toward better health (KS test, $P < 0.001$). Hunsaker *et al* reported normative values for each of the 11 American Academy of Orthopedic Surgeons (AAOS) scales, including the lumbar spine scale.²⁴ They reported uniformly high scores, skewed toward better health.²⁴ Bowland reported similar results with the SF-36.¹⁸ This appears to be a common feature of many HRQOL instruments.^{18,24}

A potential shortcoming in our study is that volunteer history of back pain was not an exclusion criterion. We would counter that the SRS-HRQOL tool was developed to evaluate the many facets of spinal deformity: pain, function, self-image, and mental health; it is not a back pain/disability index. If we had excluded volunteers with a history of back pain, it is very possible the mean pain domain scores would have been higher (better) than the mean ranges of 4.23 to 4.57 reported by our volunteer population. For normative data to be valid, it must be based on a well-defined and representative sample of the population. Considering the prevalence of lower back pain in the general population, excluding back pain would not have provided a true representation of the population. Furthermore, our volunteer population had no history of scoliosis or prior spine surgery, allowing us to assume domain scores were associated with the factors unrelated to spinal deformity. In addition, the presence of comorbidities and/or specific symptom(s) was not an exclusion criterion cited in the HRQOL normative data publications referenced in this paper. Specifically, normative data published for the eleven limb/joint specific AAOS outcomes instruments included all individuals who responded to the random mailings. Volunteers

who reported musculoskeletal problems for which they had or had not sought medical treatment were not excluded from the analysis.²⁴

Much of the SF-36 data normative data are reported in 10-year generational age groups, yet we intentionally selected 20-year age groups. We analyzed our volunteers in age groups that would reflect the concomitant progression of degenerative symptoms and conditions seen in spinal deformity patients. The variability seen in the domain scores of age-gender groups underscores the need to use age-specific normative data when available.

Previous studies have confirmed that the SRS instrument is a valuable HRQOL tool, sensitive to disease-specific differences in pain, self-image, and activity of the adult spinal deformity patient. With this investigation we have established population medians, means, confidence intervals, standard deviations, and percentiles for the domains of the SRS-30 HRQOL questionnaire in adult unaffected by scoliosis. These results will provide a reference allowing clinicians and investigators to interpret and compare domain scores of individuals or groups of deformity patients to their nondeformity generational peers.

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➤ Key Points

- ❑ This study reports normative medians, means, standard deviations, percentiles and confidence intervals for the Scoliosis Research Society (SRS)-30 HRQOL instrument in an adult population unaffected by scoliosis.
- ❑ Domain median scores ranged from 4.1 to 4.6 for all age-gender groups.
- ❑ The older the age group, the lower (worse) the reported domain means, regardless of gender. The only exception was the female mental health scores where slightly larger means were reported in the older age groups.
- ❑ Males reported higher (better) scores than their female counterparts.

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