

Population-based normative data for the Scoliosis Research Society 22r, EQ-5D, and VAS questionnaires among individuals aged 20 to 69 years

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Aims

To provide normative data that can assess spinal-related disability and the prevalence of back or leg pain among adults with no spinal conditions in the UK using validated questionnaires.

Methods

A total of 1,000 participants with equal sex distribution were included and categorized in five age groups: 20 to 29, 30 to 39, 40 to 49, 50 to 59, and 60 to 69 years. Individuals with spinal pathologies were excluded. Participants completed the Scoliosis Research Society-22 (SRS-22r), visual analogue scale (VAS) for back/leg pain, and the EuroQol five-dimension index (EQ-5D/VAS) questionnaires, and disclosed their age, sex, and occupation. They were also categorized in five professional groups: doctors, nurses, allied health professionals, office workers, and manual workers.

Results

The mean age of all participants was 43.8 years (20 to 69). There was no difference in the SRS-22r, EQ-5D, or VAS scores among male and female participants ($p > 0.05$). There was incremental decrease in SRS-22r total scores as the age increased. The mean EQ-5D index score (0.84) ranged little across the age groups (0.72 to 0.91) but reduced gradually with increasing age. There was difference between the SRS-22r total score (4.51), the individual domain scores, and the EQ-5D score (index: 0.94 and VAS: 89) for the doctors' group compared to all other occupational categories ($p < 0.001$). Doctors had a younger mean age of participants, which may explain their improved spinal health. There was no difference in the total or sub-domain SRS-22r and EQ-5D scores between the other four occupational groups.

Conclusion

This study provides the first normative data for the SRS-22r, EQ-5D, and VAS for back/leg pain questionnaires among adults in the UK. We recorded an excellent correlation between the three assessment tools with individuals who reported less back and leg pain having better quality of life and greater function. The participants' age, rather than their sex or profession, appears to be the major determinant for spinal health and quality of life.

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Introduction

Chronic pain (pain lasting more than three months) affects between one-third and one-half of the population in the UK corresponding to just fewer than 28 million adults. Back pain is one of the commonest presentations in the primary and emergency care settings. With an ageing population, the

prevalence of back pain, and the financial and psychological impact this has on society and the allocation of healthcare resources, is increasing.¹

Validated questionnaires including EuroQol 5-dimension (EQ-5D) and Scoliosis Research Society 22r (SRS-22r) are frequently used to investigate the impact of

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Table I. Demographic data and scores for the total study population.

Variable	Total population (n = 1,000)	20 to 29 yrs (n = 200)	30 to 39 yrs (n = 200)	40 to 49 yrs (n = 200)	50 to 59 yrs (n = 200)	60 to 69 yrs (n = 200)
Mean age, yrs (range)	43.8 (20 to 69)	25.4	34.3	44.6	54.8	63.9
Mean SRS-22r Function (range)	4.16 (1.5 to 5)	4.51 (2 to 5)	4.23 (2.8 to 5)	4.2 (2.8 to 5)	4.03 (2.6 to 4.8)	3.58 (1.5 to 4.6)
Mean SRS-22r Pain (range)	4.2 (1.8 to 5)	4.58 (2.6 to 5)	4.3 (2.2 to 5)	4.28 (3 to 5)	3.98 (2 to 5)	3.35 (1.8 to 4)
Mean SRS-22r Image (range)	4.01 (2.2 to 5)	4.37 (2.6 to 5)	4.04 (2.8 to 5)	3.96 (2.4 to 5)	3.86 (2.2 to 5)	3.4 (1.7 to 4.2)
Mean SRS-22r Mental Health (range)	3.9 (1.2 to 5)	4.22 (2.6 to 5)	3.87 (2.4 to 5)	3.92 (2 to 5)	3.9 (1.6 to 5)	3.48 (1.2 to 4.3)
Mean SRS-22r Total (range)	4.06 (1.3 to 5)	4.42 (3.2 to 5)	4.11 (2.8 to 4.8)	4.08 (2.9 to 4.8)	3.9 (1.3 to 4.6)	3.45 (1.3 to 4.2)
Mean EQ-5D VAS (range)	78 (30 to 100)	86 (50 to 100)	83 (35 to 100)	83 (45 to 100)	79 (30 to 100)	65 (30 to 80)
Mean EQ-5D Index (range)	0.84 (0.1 to 1)	0.91 (0.65 to 1)	0.85 (0.35 to 1)	0.86 (0.5 to 1)	0.8 (0.1 to 1)	0.72 (0.1 to 0.8)
Mean VAS Back (range)	2.44 (0 to 9)	1.12 (0 to 8)	1.7 (0 to 8)	1.43 (0 to 7)	2.37 (0 to 9)	4.2 (0 to 9)
Mean VAS Leg (range)	2.06 (0 to 10)	0.75 (0 to 9)	1.32 (0 to 10)	1.06 (0 to 8)	1.95 (0 to 9)	3.1 (0 to 10)

EQ-5D, EuroQol five-dimension; SRS, Scoliosis Research Society; VAS, visual analogue scale.

spinal pathologies, such as scoliosis, in the quality of life of adolescent and adult patients.² Both the EQ-5D and SRS-22r are included in the British Spine Registry, which comprises a database of patients with spinal conditions treated surgically, as measures to assess patient-perceived outcomes. However, these questionnaires have not been used to investigate the quality of life of the general population, in those individuals without a diagnosed spinal disorder in the UK. Providing normative values for the general population will highlight information on specific aspects of life that are affected, and identify areas that public health campaigns and healthcare policymakers can target. Quality of life data from the general population can also act as a baseline for comparison against data recorded from patients with spinal conditions.

The purpose of this population-based study was to present normative data for the UK adult population using validated questionnaires including the SRS-22r, EQ-5D, and the visual analogue scale (VAS) for back and leg pain. By generating these data, we aimed to provide evidence on the prevalence of back pain and spinal-related disability in the population of the UK that does not have diagnosed spinal pathologies.

Methods

Study population. Participants were randomly selected from the Scottish population with the aim to represent individuals aged between 20 and 69 years with equal sex and age distribution across the range investigated. Any individual who reported a diagnosis or previous investigations for a spinal condition was excluded. Our cohort consisted of 1,000 individuals who were residents within Scotland (491 males, 509 females); 48 (4.8%) of them were born in another country than the UK. The participants had to disclose their age, sex, and employment status. The data were collected and analyzed anonymously by the Data Coordinator for our service. Institutional review board approval was obtained.

Table II. Questionnaire data presented according to sex.

Variable	Female	Male	p-value*
Total number	509	491	N/A
Mean age, yrs (range)	43.7 (20 to 69)	44 (20 to 69)	0.756
Mean SRS-22r Function (range)	4.15 (1.8 to 5)	4.17 (1.5 to 5)	0.587
Mean SRS-22r Pain (range)	4.21 (1.8 to 5)	4.19 (2 to 5)	0.763
Mean SRS-22r Image (range)	4 (2.4 to 5)	4.02 (2.2 to 5)	0.689
Mean SRS-22r Mental Health (range)	3.84 (1.2 to 5)	3.95 (1.8 to 5)	0.558
Mean SRS-22r Total (range)	4.05 (1.3 to 5)	4.06 (1.4 to 5)	0.934
Mean EQ-5D VAS (range)	77.3 (30 to 100)	78.5 (30 to 100)	0.863
Mean EQ-5D Index (range)	0.83 (0.1 to 1)	0.85 (0.2 to 1)	0.923
Mean VAS Back (range)	2.44 (0 to 9)	2.45 (0 to 9)	0.967
Mean VAS Leg (range)	2 (0 to 10)	2.1 (0 to 9)	0.897

*Independent-samples *t*-test.

EQ-5D, EuroQol five-dimension; N/A, not applicable; SRS, Scoliosis Research Society; VAS, visual analogue scale.

Questionnaires. The SRS-22r is a validated questionnaire developed to measure quality of life in scoliosis patients. It comprises 22 questions, divided across five domains (function, pain, self-image, mental health, and satisfaction) and each question has five answers (1 being the worst and 5 being the best score).³ An index number is calculated for each domain and a total figure is generated for all domains combined. Of note, the satisfaction domain cannot be used in individuals who have not undergone treatment for scoliosis. Therefore, in this report we present the SRS-22r sub-total score that excludes the satisfaction domain, similar to previous studies.⁴

The EQ-5D is a general health questionnaire in which individuals score their own health across five domains in a descriptive system (index): mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.^{5,6} In this study, individuals chose one of five options indicating how they assess their health in each domain. The

Table III. Total study population data based on professional categories.

Variable	Doctors	Nurses	Allied health professionals	Office workers	Manual workers
Total number	203 (51% male)	223 (71% female)	181 (52% female)	198 (61% female)	195 (80% male)
Mean age (range)	33 (21 to 59)	39 (20 to 61)	42 (21 to 63)	45 (20 to 69)	47 (23 to 64)
Mean SRS-22r Function (range)	4.52 (2.8 to 5)	4.26 (2 to 5)	4.2 (2.2 to 5)	4.09 (1.5 to 5)	4.02 (1.8 to 5)
Mean SRS-22r Pain (range)	4.66 (3.1 to 5)	4.21 (2.2 to 5)	4.14 (2 to 5)	4.22 (2.1 to 5)	4.07 (1.8 to 5)
Mean SRS-22r Image (range)	4.45 (3.3 to 5)	4.02 (2.5 to 5)	4.04 (2.3 to 5)	3.84 (2.4 to 5)	3.8 (2.2 to 5)
Mean SRS-22r Mental Health (range)	4.46 (3 to 5)	3.85 (1.8 to 5)	3.9 (2.2 to 5)	3.69 (1.2 to 5)	3.86 (2 to 5)
Mean SRS-22r Total (range)	4.51 (3.8 to 5)	4.09 (3.2 to 5)	4.02 (2.9 to 5)	3.95 (2.6 to 5)	3.92 (2.5 to 5)
Mean EQ-5D VAS (range)	89 (60 to 100)	82 (50 to 100)	82 (40 to 100)	80 (30 to 100)	77 (35 to 100)
Mean EQ-5D Index (range)	0.94 (0.6 to 1)	0.84 (0.4 to 1)	0.83 (0.2 to 1)	0.81 (0.3 to 1)	0.79 (0.1 to 1)
Mean VAS Back (range)	0.97 (0 to 6)	1.79 (0 to 8)	1.98 (0 to 9)	1.53 (0 to 9)	2.45 (0 to 9)
Mean VAS Leg (range)	0.67 (0 to 7)	1.48 (0 to 10)	1.08 (0 to 8)	1.15 (0 to 9)	2.32 (0 to 10)

EQ-5D, EuroQol five-dimension; SRS, Scoliosis Research Society; VAS, visual analogue scale.

answers were then translated to correspond with an index figure representing the population's perception on general health. The UK standard tariff was used as a reference where the EQ-5D index score ranges between -0.59 (worst) and 1.0 (best).⁷ The EQ-5D also includes the EQ-VAS which records the individual's self-rated health on a vertical visual scale with 100 being the best and 0 the worst health imaginable.

The VAS is a rating system that represents a self-reported measure of back and leg pain. Individuals record a point on a continuous 10 cm line between no pain on the left and worst pain on the right. This is subsequently interpreted to give a score between 0 (no pain) and 10 (worst pain).⁸

Statistical analysis. Data are presented as mean values and ranges (Tables I to III). Data was analysed using SPSS v. 27.0 (IBM, USA). Individuals were stratified according to their age in the following five categories: 20 to 29, 30 to 39, 40 to 49, 50 to 59, and 60 to 69 years. They were also categorized depending on their profession: doctor, nurse, allied health professional, office worker, and manual worker. The Pearson's correlation test was used to analyze correlations between various domains from the SRS-22r, EQ-5D, and VAS responses ($r > 0.2$ was considered significant). The paired *t*-test was used to analyze the sub-scores from the SRS-22r, EQ-5D, and VAS questionnaires across all age groups and occupation categories ($p < 0.05$ was considered significant), and the independent-samples *t*-test was used to compare male and female participants.

Results

There were 1,000 participants in this study, with 200 individuals included in each age group (Table I). The mean age of all participants was 43.8 years (20 to 69). There was no significant difference in the SRS-22r (domain and total), EQ-5D (index and VAS), or the VAS scores for back and leg pain among male and female participants (Table II). There was an incremental decrease in the total

SRS-22r score as the age group increased. The youngest group (20 to 29 years) had the highest total SRS-22r score and the oldest group (60 to 69 years) had the lowest total score ($p < 0.001$, paired *t*-test). Across each domain, namely function, pain, image, and mental health as the age increased the mean sub-domain score decreased incrementally. The most significant reduction in SRS-22r individual domain and total scores occurred in the oldest 60 to 69 year category compared to any other age group ($p < 0.001$). There was also a notable reduction in the SRS-22r total and sub-domain scores between the 20 to 29 and the 30 to 39 year groups (total $p = 0.011$; function $p = 0.024$; pain $p = 0.035$; image $p = 0.009$; mental health $p = 0.012$, all paired *t*-test).

The EQ-5D score for the age groups is shown in Table I. The total EQ-5D index score (0.84) ranged little across the age groups (0.72 to 0.91) and demonstrated a gradual reduction as age increased, which was not significant. In contrast, the EQ-5D VAS score (78) had a wider variation between the age groups (65 to 86), which was significant when comparing the youngest (20 to 29 years) and the oldest (60 to 69 years) age groups ($p < 0.001$, paired *t*-test). The total population VAS score was 2.44 and 2.06 for back and leg pain, respectively. In the older age groups (50 to 59 and 60 to 69 years), the EQ-5D index and the EQ-5D VAS scores reduced, while the VAS scores for back and leg pain gradually increased, with the differences in the VAS scores being significant compared to the younger age groups (Table I; $p < 0.001$, paired *t*-test).

Using the Pearson's correlation coefficient the *r* value was 0.65 ($p < 0.001$, Pearson correlation coefficient test (null hypothesis)) when comparing the SRS-22r total scores and the EQ-5D index scores for the whole population. Comparison of the SRS-22r sub-domain scores to the EQ-5D index scores indicated $r = 0.64$ ($p < 0.001$) for function, $r = 0.64$ ($p < 0.001$) for pain, $r = 0.5$ ($p < 0.001$) for image, and $r = 0.5$ ($p < 0.001$) for mental health. The correlation between the SRS-22r total scores and the VAS scores for back and leg pain for the whole cohort was $r =$

-0.64 ($p < 0.001$) and $r = -0.47$ ($p < 0.001$), respectively. The correlation between the EQ-5D index scores and the VAS scores for back and leg pain was $r = -0.56$ ($p < 0.001$) and $r = -0.43$ ($p < 0.001$), respectively. These results suggest that individuals who reported less back and leg pain had greater SRS-22r total and EQ-5D index scores, indicating better quality of life and greater function.

The occupational status of the 1,000 participants was also recorded (Table III). There were five groups of professionals that took part in this study: doctors, nurses, allied health professionals, office workers, and manual workers. There was variation in the male to female ratio across the five occupational groups with the nurses having a majority of female participants (71%) and the manual workers being predominantly male (80%). The mean age in the doctors' group was significantly lower compared to all other professional categories (33 years, $p < 0.001$, paired *t*-test). There was a significant difference between the total SRS-22r score (4.51) and the individual domain scores for the doctors' group when compared to all other professional categories ($p < 0.001$). In contrast, there was no significant difference in the total or sub-domain SRS-22r scores between the other four occupational groups. Similarly, the doctors' group had significantly higher EQ-5D scores (index: 0.94 and VAS: 89) when compared to all other occupational groups ($p < 0.001$). There was no significant difference in the EQ-5D scores between the other four professional groups. In addition, the VAS scores for back and leg pain were significantly lower in the doctors' category (0.97 and 0.67, respectively) when compared to all other professional groups ($p < 0.001$). There was no significant difference in the VAS scores between the other four occupational groups.

Discussion

This large population-based study presents normative data for the SRS-22r, EQ-5D, and VAS questionnaires for the adult population in the UK. Variation in the SRS-22r, EQ-5D, and VAS scores was recorded across the age range, with the responses being inversely proportional to the participants' age; poorer scores were documented across all domains in the older age categories. There was good statistical correlation between the SRS-22r, EQ-5D index, and VAS scores for back and leg pain, similar to previous population studies from Sweden and Slovenia.^{4,9} Notably, there was minimal variation in the scores across the majority of the occupations recorded, apart from the doctors' group, which scored significantly better in all domains assessed. This is likely to be due to the statistically younger age of individuals recruited in the doctors' category compared to all other professional groups.

A study from the USA presented population-based data among 34 adults and recorded similar scores for the sub-domains of the SRS-22r questionnaire (4.1 to

4.3) to our study.² Similarly, a study of 272 participants representing all ages between ten and 69 years from Sweden reported high average SRS-22r scores across the domains (4.3 to 4.7) in all age categories.⁴ The sample populations in these two previous studies were much smaller when compared to our cohort and the age categories were broader. Additionally, the Swedish study included a younger age group, which probably explains why the mean SRS-22r scores were proportionately higher than ours, as the younger the population, the higher the SRS-22r score.

There were variations in the recorded scores between the different age groups assessed with the various questionnaires in this study. Of note, individuals in the age group 30 to 39 years had a reduced score in the SRS-22r total and sub-domain scores, as well as the EQ-5D scores, with parallel increase in the VAS back and leg pain scores compared to the younger 20 to 29 year group. All scores remained stable in the following two decade groups (40 to 49 and 50 to 59 years), with further decrease recorded in the oldest 60 to 69 year group. The reduction in mental health domain and EQ-5D index scores has been reported to occur in the middle-aged adult groups compared to younger individuals, but not as young as in the 30 to 39 year group, which was the observation in our study.^{4,10}

In this study, the impact of occupation on spinal-related quality of life, and back and leg pain, was investigated. There was no significant difference in the SRS-22r, EQ-5D, and VAS scores for back and leg pain across the majority of occupations apart from the results recorded in the doctors' group. Ozguler et al¹¹ reported little association between profession and back pain in the general population which included healthcare, manual, and office workers. Manual workers and healthcare workers are considered high-risk professionals for having reduced health-related quality of life,¹⁰ and for developing long-term back pain.¹¹ Our study has shown little difference between high- and lower-risk professions regarding spinal-related quality of life, as well as back and leg pain when assessed with validated health questionnaires. Doctors were the only occupation that demonstrated significantly better scores across all questionnaires used in this study, but this group had a significantly younger mean age of participants than the other four cohorts. We, therefore, conclude that the individuals' age is the major determinant of their spinal health and overall quality of life, rather than their professional activity. Equally, we did not document a difference in reported quality of life and perception on spinal-related problems between male and female participants, even though there was a variation in the distribution of female and male individuals among the five occupational groups.

We recorded a high correlation between the SRS-22r (total and sub-domain scores), EQ-5D questionnaires, and VAS back and leg pain scores among our participants who were members of the general population with no history of spinal conditions. We suggest that using both disease-specific and generic quality of life reporting tools is beneficial when assessing the general population for spinal-related quality of life, as well as for frequency and severity of back/leg pain.

There are limitations in this study. Our study cohort has a wide age range, but we did not include children and adolescents as the purpose was to document spinal health and quality of life among the adult general population. We excluded patients with diagnosed spinal conditions as the aim was to document spinal-related quality of life among unaffected individuals. We also did not obtain information from our participants related to their general health and existing medical conditions, which could have been useful when investigating the prevalence of back pain.

This study provides the first normative data for the SRS-22r, EQ-5D (index and VAS), and VAS for back and leg pain questionnaires in the adult population of the UK. There is a need for country-specific normative values to assist with public health designed strategies in the treatment of spinal conditions and the management of back pain. We have demonstrated excellent correlation between these three assessment tools, providing a useful reference for spinal health, quality of life, and back pain in the general adult population. These data can be a useful reference to guide public health policies in the adult population, and allow comparison with treatment reported outcomes in patients with spinal pathologies.



Take home message

- This study provides the first normative data for the Scoliosis Research Society (SRS)-22r, EuroQol five-dimension questionnaire (EQ-5D), and visual analogue scale (VAS)

for back/leg pain questionnaires that can guide public health policies among adult individuals in the UK.

- We recorded an excellent correlation between the three assessment tools with those participants who reported less back and leg pain having better spinal health and quality of life, and greater function.

- We documented a significant reduction in the SRS-22r total and sub-domain scores, as well as the EQ-5D scores with parallel increase in the VAS back and leg pain scores between the 20 to 29 and the 30 to 39 year groups. Further decrease in all scores was recorded in the oldest year group (60 to 69).

- The participants' age, rather than their sex or profession, appears to be the major determinant for their spinal health and quality of life.

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