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Early View

Original Research Article

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Longitudinal validation of King's Sarcoidosis Questionnaire in a prospective cohort with mild sarcoidosis

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Take Home Message:
We advanced the validation of King's Sarcoidosis Questionnaire by known groups validity and assessments of responsiveness. We demonstrated good reliability, validity, and responsiveness for assessing quality of life in a cohort with mild sarcoidosis.

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Introduction

Sarcoidosis is a highly variable granulomatous disease of unknown etiology. Sarcoidosis primarily involves lungs and intrathoracic lymph nodes but can potentially affect any organ. Many patients have mild and self-limiting disease; some have a more chronic trajectory, and a minor subset of patients develops severe sarcoidosis with permanent organ dysfunction.

Disease extent and activity are determined from objective measures such as pulmonary function tests, blood assays, and imaging. It is increasingly recognized that many patients with sarcoidosis have impaired health-related quality of life (HRQoL) and a great burden of symptoms often not correlated to parameters of disease activity [1, 2]. Patient related outcome measures (PROMs) have not routinely been included in the follow-up in patients with sarcoidosis. In a survey, patients with sarcoidosis rated their QoL and functionality the most important outcomes in management of the disease [3]. QoL has been recommended as an endpoint in clinical trials [4]. This emphasizes the importance of including PROMs in the overall assessment of sarcoidosis severity and impact on patient's lives and the need for clinically applicable and validated questionnaires.

Different PROMS have been used in sarcoidosis though few being disease-specific [5]. The King's Sarcoidosis Questionnaire (KSQ) is a brief questionnaire assessing HRQoL in patients with sarcoidosis. The KSQ was developed and validated in an English sarcoidosis cohort [6] and has been validated in other languages [7, 8] but further validation is needed. The 12-month longitudinal performance of the KSQ has not previously been assessed, nor has the KSQ been validated in sarcoidosis patients with milder disease.

This study aimed to validate the KSQ, including longitudinal validation over a 12-month period and known groups validity, in a population with mild sarcoidosis. Mild sarcoidosis was defined as patients with mean preserved pulmonary function, majority with Scadding stage (0-I) and compared to previous studies, a lower subset of patients with extrapulmonary organ involvement, need for treatment and long disease duration [6, 8–10].

Methods

Study population

The study was a prospective observational cohort study. From December 2019 to December 2021 patients with sarcoidosis were consecutively recruited from Center of Rare Lung Diseases, Aarhus University Hospital, Denmark. Adult patients with a diagnosis of sarcoidosis based on the most recent ATS diagnostic criteria [9] able to understand and complete the questionnaires, were eligible for inclusion. The sample size arrived from these criteria. Participants signed written informed consent.

The study was approved by the Central Denmark Region Data Protection Agency (case number: 1-16-02-90-19) and acknowledged by the Central Denmark Region Committee on Health Research Ethics.

Questionnaires

The *KSQ* is a 29-item questionnaire with 5 domains: General Health Status (GHS) (10-item), Lung (6-item), Medication (3-item), Skin (3-item), and Eyes (7-item), scored on a 7-point Likert scale. GHS domain is administered to all patients and additional domains are completed individually depending on organ involvement and treatment. The total health status score is determined by combining the modules (ex: GSH-Lung). Scoring is calculated using a re-ordered scale for appropriate items; higher scores indicate better HRQoL [6]. The minimal clinically important difference (MCID) for the KSQ GHS and Lung modules has been estimated, and is 8 for GHS, and 4 for Lung [10]

Linguistic validation

The KSQ was translated into Danish following acknowledged guidelines [16]. Initially, a forward translation was performed by two Danish native-speaking translators. The two versions were merged, and consensus was reached in the presence of differences between the two translations. A native English-speaking translator, blinded to the original English version, back translated the merged version, and the original author reviewed the translation.

Ten patients with sarcoidosis of different gender, age, radiologic stage, and organ involvement completed the questionnaire followed by a semi-structured interview. Patient interviews were subsequently reviewed by an expert panel.

The *King's Brief Interstitial Lung Disease Questionnaire (K-BILD)* is a 15-item questionnaire used for HRQoL measurement in different interstitial lung diseases. This questionnaire was included as many sarcoid patients exhibit interstitial lung changes. Patients score on a 7-point Likert scale resulting in a total score (Tot) and three domain scores: Psychological (Psy), Breathlessness and activities (BA) and Chest symptoms (CS). Scores range from 0 to 100, higher scores indicate better HRQoL. K-BILD was validated in a large Danish cohort of patients with idiopathic pulmonary fibrosis [11] [12]

The *Short Form-12 (SF-12)* is a 12-item generic outcome measure assessing the impact of health on everyday life in a 3- to 5-point Likert scale. SF-12 is a shortened version of the SF-36 created to reduce the burden of response. Scores are recorded on 8 health domain subscale and a weighted sum score of these are converted to a T score (mean = 50, standard deviation = 10), lower T-scores indicating worse HRQoL. Results are gathered in a Physical Component Summary (PCS) and a Mental Component Summary (MCS) used for the criterion-based interpretation [13]

The Medical Research Council (MRC) dyspnea scale is a 1-item, 5-point score grading of the effect of breathlessness on daily activities with a high score comprising severe dyspnea.

The Fatigue assessment scale (FAS) is a 10-item questionnaire designed to assess fatigue in the general population and subsequently validated in a sarcoidosis setting [14]. The five response categories range from "never" to "always" and the total score ranges from 10-50 with higher scores indicating more fatigue.

The Global Rating of Change Scales (GRCS) is a single-item 11-point instrument assessing the perception of improvement/deterioration over time [15].

All questionnaires were self-reported.

Study procedure

At inclusion patients completed the KSQ, F-12, K-BILD, MRC, and FAS; after 14 days KSQ and GRCS were completed. After 12 months, KSQ, SF-12, K-BILD, MRC, and FAS were completed.

Data on demographics, organ manifestations, pulmonary function tests, Scadding stages and treatment were retrieved from medical charts. Patients self-completed the questionnaires when attending the clinic after medical consultation. After 14 days the KSQ and the GRCS were completed at home. Questionnaires with less than 85% completion were excluded.

Psychometric validation and Statistical analysis

Reliability

1. Internal consistency, the interrelatedness of the items in the questionnaire, was estimated by calculating Cronbach's α for each domain. Values > 0.7 indicate a sufficient internal consistency[16].

2. Test-retest reliability was evaluated by Intraclass correlation coefficients (ICC) and Bland-Altman plots comparing the KSQ scores at baseline and at 14 days in stable patients. Patients with a score of -1 to 1 in the GRCS at 14 days were considered stable. ICC values > 0.7 are considered reliable measures of reliability [17]. The limits of agreement were calculated as mean ± 1.96 x SD of within-subject differences.

Validity

Concurrent validity was assessed by measuring the correlation of the KSQ to the SF-12, the K-BILD, the MRC, the FAS, and forced vital capacity (FVC) using Pearson's correlation coefficients. A correlation coefficient of < 0.30 is considered weak, 0.30-0.50 moderate, and > 0.50 strong.

Normal distribution of data was assessed using histograms and Q-Q plots. Categorical variables are presented as percentages of the total population. Students t-test was used to evaluate differences among genders. Variance homogeneity was assessed using the F-test. For non-normality data, the Spearman correlation was applied.

Known groups validity was investigated by estimating the ability of the KSQ to distinguish between groups of patients with different severity of disease. Patients were stratified into "known groups" according to their fatigue score, FVC, and the need for treatment. The independent two-sample t-test was used for comparison when scores in the known groups followed a normal distribution, and otherwise, the Wilcoxon-Mann-Whitney test was applied. Effect sizes were calculated from

analysis of variance and were reported as partial η^2: small effect 0.01, medium effect 0.06, and large effect 0.14.

Responsiveness

The ability to detect changes over time was assessed by measuring changes in the KSQ over 12 months and correlating to changes in: SF-12, K-BILD, MRC, FAS, and FVC using Pearson's correlation coefficient. Non-normality data was logarithmic transformed, otherwise the Spearman correlation was applied. Weaker correlations compared to concurrent validity were expected due to larger variations in changes in the two measures.

Analysis

Analyses were conducted using the Stata/BE 17.0 for Mac statistical software package.
We hypothesized good correlations of the GHS to the SF-12 and FAS and a good correlation between Lung and the K-BILD and the MRC. We expected a poorer correlation of the KSQ to FVC.

We expected negative correlations for MRC and FAS due to inverse scoring scales.

Missing data, lost to follow up, withdrawal of consent, death and other reasons were managed by data reduction.

Results

Linguistic validation

The translational process identified no major issues. Minor differences between the two translations were resolved by review and discussion. The back translation was approved by the original author. Patient interviews demonstrated high face and content validity of the Danish version of the KSQ (See Supplementary). Evaluation of patient interviews in the expert group did not necessitate any further adaptations.

Participants

A total of 163 patients met the inclusion criteria. 150 patients accepted participation and completed the KSQ at baseline. The demographics of patients shown in Table 1. After 12 months 128 patients

completed the KSQ. Of the remaining, two had died, four was lost to follow up, six withdrew their consent and 10 did not complete or was not provided the questionnaire.

We found overall male predominance and a relatively mild affected cohort judged from pulmonary function tests, Scadding stage, number of patients with extrapulmonary organ involvement, and need for treatment. The majority (63%) were incident patients diagnosed within 6 months and the rest within 3 years from diagnosis. Extensive baseline characteristics of the cohort have been described previously [2]. The KSQ-GHS was significantly higher in men compared to women, (mean (95% CI) 68 (64.5; 70.7) and 61 (56.6; 64.7), respectively, mean difference -7 (-12.0; -2.0). Patients with fatigue (FAS score $\geq$ 22) had a significantly worse GHS: 55.2 (95% CI: 52.5; 57.3) than patients with lower fatigue scores: 75.7 (72.8; 78.6), mean difference 20.8 (95% CI: 17.0; 24.5).

Psychometric validation

Reliability

All domains of the KSQ showed good internal consistency with Cronbach's $\alpha > 0.70$ (Table 2). Due to the low number of patients with skin and eye involvement and even lower numbers of completed 14 days follow-up questionnaires, these two subdomains were excluded from further analyses.

Most patients were categorized as stable from their completion of the GRCS after 14 days (Table 3). In stable patients, test re-test showed high intercorrelation coefficients > 0.7 and thus suggested good reliability of the KSQ (Table 3).

Bland-Altman plots for the GHS and Lung visualize the agreement between scores at baseline and after 14 days though both plots contain some outliers outside the 95% limits of agreement. The plot for Lung showed a slight tendency to increased variation with higher scores. (Figure 1).

Concurrent validity

The GHS domain correlated strongly to the SF-12, the K-BILD, and the FAS (-0.78 -0.55) and moderately to the MRC and FVC (-0.45-0.31). The KSQ Lung showed moderate correlations to the SF-12 and FVC and strong correlations to the K-BILD, the MRC, and the FAS.

The GHS-Lung combined correlated strongly (-054 -0.82) to all tested parameters except FVC (0.38).
The medication domain correlated strongly to the FAS, the K-BILD, (Tot, Psy), and the SF-12 (MCS), moderately to the K-BILD (BA and Chest) and the MRC, and weakly to the SF-12 (PCS) and FVC (Table 4).

Known groups validity

At baseline, patients in the upper quartiles of FVC % predicted (n= 35 (18 males), mean age 51.9 (95% CI: 46.5; 57.4)) and lower quartiles of the FAS scores (n=37 (27 males), mean age 51.8 (95% CI: 47.2; 56.4)) had significantly higher GHS, Lung, and GHS-Lung scores than patients in the lower quartiles of FVC % predicted (n=39 (25 males), mean age 49.3 (95% CI: 44.2; 54.3)) and the upper quartiles of the FAS scores (n=35 (16 males), mean age 44.7 (95% CI: 40.0; 49.5)) (Table 5). Patients on or initiating treatment at baseline (n=47 (27 males), mean age 46.5 (95% CI: 42.2; 50.8)) scored significantly lower on total scores compared to patients without treatment (n=103 (62 males), mean age 48.4 (95% CI: 45.7; 51.2)), visualized for the GHS-Lung (Figure 2).

Responsiveness

Over 12 months, the mean HRQoL (GSH and Lung) improved significantly (n=128): GHS: 64.66 to 69.57, mean difference 4.91 (95% CI: 2.62; 7.20). Lung: 66.99 to 70.19, mean difference 3.19 (95% CI: 0.23; 6.16). GHS-Lung: 67.30 to 70.52, mean difference 3.22 (95% CI: 1.50; 4.94). Medication scores were stable (n=21): 62.10 to 64.00, mean difference 1.91 (95% CI -13.00; 0.17). Using the MCID of 8 for GHS, 60 patients (47%) improved, 21 (16%) deteriorated, and 47 (37%) were stable. Using the MCID of 4 for Lung, 65 (51%) improved, 39 (30%) deteriorated, and 24 (19%) remained stable. There was no difference in the change in KSQ score between treated and untreated patients: GHS: mean difference -0.16 (95% CI: 5.43; 5.11), LUNG: mean difference -2.45 (95% CI: -9.24; 4.3), GHS-LUNG: mean difference: 0.1530144 (95% CI: -3.79; 4.10).
Table 6 shows correlations between changes in the KSQ and changes in anchors from baseline to 12 months.
Correlation of changes in all domains of the KSQ was moderate or strong for the MCS, the K-BILD, and the FAS (r=0.30-0.70) and weak for the PCS and FVC (r= 0.01-0.29), except for Medication modules correlation to the SF-12.

Discussion

Our study contributes to the validity of the KSQ. This is the first study to assess 12-months responsiveness, known groups validity and investigate the performance of the KSQ in a mild diseased sarcoidosis population.

We were able to fully validate the GSH, Lung, and Medication domains. The KSQ showed good face and content validity.

The KSQ demonstrated high discriminative ability in known groups of patients regarding the FAS score, FVC and treatment. This is supported by the moderate to large effect sizes. During12 months mean HRQoL improved for the KSQ domains. This is compatible with the overall perception of mild sarcoidosis being a benign disease that tends to naturally resolve within a few years for most patients. Also, in line with the fact that our cohort had mild disease with predominantly incident patients and a considerable proportion with Löfgrens syndrome [2]. The longitudinal validation showed that the KSQ was responsive to change over time and correlated with the anchors to a similar degree as the correlations at baseline. Most correlations were moderate but due to measurement error on two measures, correlations between changes in scores are expected to be smaller than of the exact values. Baughman et. al. estimated the MCID for the KSQ (GHS and Lung). They evaluated changes in scores over 6 months in a more severely ill sarcoidosis population and found the strongest correlations with the SGRQ, the SF-36, and the FAS[18], though correlations overall were weaker than in this study.

The internal consistency was high with Cronbach's $\alpha > 0.70$ for all domains. This is comparable with the findings of previous validation studies [6, 8, 19].

The KSQ showed good repeatability in terms of test-retest results with ICC above 0.70 comparable with the KSQ validation in a Dutch study population [7], though not as high as found in the original study [6]. Repeatability was not tested in the German validation study [8]. However, an increased variability was observed in higher scores for the Lung domain and may be attributed to more similar answer options within the high score range, leading to more inconsistency in patient responses. Alternatively, patients experiencing fewer symptoms may exhibit greater variability over a short period.

The concurrent validity of the questionnaire was high; in particular, we found a strong correlation between the GHS, Lung, and GSH-Lung to the K-BILD total and the FAS.
Contrary to our hypothesis, we found a weak correlation of the KSQ domains to the SF-12 (PCS) compared to studies using the SF-36 and the WHO-QOL indicating that the SF-12 is a less reliable generic questionnaire relating to sarcoidosis. The better correlation of the KSQ to the SF-12 (MCS) than the correlation to SF-12 (PCS) probably reflects that health status and quality of life in patients with sarcoidosis are greatly influenced by fatigue and mental/psychological factors. This tendency was also observed in the original British and German study when correlating to the SF-36 (PCS and MCS) [6, 8].
We chose the K-BILD as an anchor because it is short, easy to complete and validated in interstitial lung disease compared to for instance the St. George's Respiratory Questionnaire, which is longer, more complicated, and developed for obstructive lung disease (COPD). We considered sarcoidosis to have more similarities to ILD than to COPD in general, which is supported by our results showing a good correlation between the KSQ and the K-BILD.

As hypothesized, the correlations of the KSQ domains with FVC were poor, though best for the Lung domain. This has been noted several times before [6, 10, 19]. Fatigue has a huge impact on QoL in patients with sarcoidosis [20] and the poor correlations of fatigue to clinically relevant measures have previously been demonstrated in Danish sarcoidosis patients as well as in other cohorts [2, 21, 22]. Furthermore, the moderate to high correlation of all the KSQ domains to the FAS suggests that the KSQ captures the influence on QoL caused by fatigue.
The worse HRQoL in women was compatible with findings in the original and, though not significant, the Dutch study [6, 19]. This may be explained by the fact that women report more fatigue than males in this and other cohorts [2, 23, 24].
The medication module correlated better to anchors than in the previous studies [6, 19]. High correlation to: SF-12 (MCS), K-BILD (Tot, Phy) and FAS. Side effects of mainly steroid treatment may contribute to Medication scores.
Overall, the baseline validation of the KSQ showed that it is also valid, reliable, and able to distinguish between groups of sarcoidosis patients with different stages of disease in a population with mild sarcoidosis, thus increasing the applicability of the KSQ across a wider spectrum of sarcoidosis patients.

In terms of generalizability to the broader population of sarcoidosis patients in Denmark, our cohort exhibited an age and gender distribution remarkably similar to the most recent population-based register study [25]. This study indicated that 45.6% of patients were prescribed treatment within 3 months to 3 years after diagnosis, a figure slightly higher than that observed in our present study, albeit over a longer timeframe. Currently, there is a scarcity of recent clinical data on sarcoidosis in Denmark. However, Viskum's report on spirometry data from a Danish sarcoidosis cohort spanning from 1954 to 1970 sheds some light on the matter. Their findings revealed that 20% of the patients had abnormal spirometry results, mirroring our own discoveries [2, 26].

Strengths of the study included the longitudinal validation in a large number of patients, and the evaluation of the ability of the KSQ to distingue between different patient groups.
Our cohort was less affected than the cohorts compared with [6, 8, 10, 19] as evidenced by pulmonary function tests, organ involvement, and treatment requirements and thus expands the applicability of the KSQ.
The study has some limitations: The use of an additional anchor such as the GRCS for an overall estimation of change after 12 months could have strengthened the results. We do not view recall bias as a significant concern because the questionnaires used in our study cover a time frame of 2-4 weeks except for the FAS which refer to “how you usually feel”. While completing the questionnaires after the consultation might have been influenced by information from diagnostic and follow-up investigations, we maintained consistency in this procedure throughout the study. Therefore, we do not believe it substantially affected the results, as any potential influence could have been in either direction. The low number of patients with skin and eye manifestations in our study did not enable full validation of the skin and eye domains. For completeness and to facilitate cross-cultural comparisons of HRQoL outcomes in sarcoidosis research, full validation of these domains is needed.

Conclusion

This study marks an important advancement in the validation of the KSQ-GHS, -LUNG and -Medication domains by introducing known groups validity and assessments of responsiveness over 12 months. Additionally, the validation process and high validity in a cohort of patients with mild sarcoidosis is a novel contribution to the existing literature on the KSQ.

The KSQ demonstrated good reliability, validity, and responsiveness, suggesting that it is a robust instrument for assessing HRQoL in sarcoidosis patients. The performance of KSQ in a Danish population aligns well with findings from previous studies in different populations thus highlighting its versatility across diverse cultural and linguistic settings.

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Table 1

	Patients *n*=150
Age	47.4 (45.1; 49.8)
Male gender	89 (59%)
Ethnicity, Caucasian	100%
Never smokers Former smokers Current smokers N/A	97 (65%) 42 (28%) 8 (5%) 3 (2%)
Time since diagnosis, days	300 (245; 354)
FEV1 % of predicted FVC % of predicted DLco % of predicted (*n*=127)	92 (89; 94) 101 (97;103) 84 (81; 87)
Scadding stage, Chest X-ray (*n*=145) 0 I II III IV	 29 (20%) 74 (51%) 32 (22%) 7 (5%) 3 (2%)
Number of patients with extrapulmonary involvement who completed KSQ. Eyes Skin	 19 (13%) 14 (9%)
Treatment: Glucocorticoids Duration of glucocorticoids, days Methotrexate	 47 (31%) 196 (106; 285) 4 (3%)

Table 1: Patient demographics at inclusion. Numeric variables are listed as number of patients and percentages (). Continuous variables are reported as means with 95% CI (). n= number. FEV1: Forced expiratory volume. FVC Functional vital capacity. DLco: Diffusion capacity of the lungs for carbon monoxide. KSQ: King's Sarcoidosis Questionnaire. N/A: no answer.

Table 2

KSQ domain	Cronbach's α
GHS (n=150)	0.90
Lung (n=150)	0.85
Medication (n= 35)	0.75
Skin (n=14)	0.73
Eyes (n=19)	0.90

Table 2: Internal consistency: Data represent Cronbach's α for different KSQ domains. KSQ: King's Sarcoidosis Questionnaire. GHS: General health status.

Table 3

KSQ domain	*n*	ICC
GHS	88 / 110 (80%)	0.81 (0.72; 0.88)
Lung	98 / 111 (88%)	0.72 (0.60; 0.80)
Medication	19/22 (86%)	0.75 (0.46; 0.90)

Tabel 3: Repeatability of KSQ domains at baseline and after 14 days in stable patients. Data are presented as number of stable patients in (% of responders of GRCS and KSQ after 14 days.) Intraclass correlation coefficients (ICC).

Table 4

	SF-12 domains		K-BILD domains				MRC n=146	FAS n=147	FVC n=149
KSQ domain	MCS n=148	PCS n=148	Tot n=146	Psy n=147	BA n=147	CS n=148			
GHS n=150	0.72	0.58	0.74	0.65	0.69	0.55	-0.45	-0.78	0.31
Lung n=150	0.48	0.47	0.76	0.55	0.74	0.73	-0.53	-0.52	0.38
GHS-Lung n=150	0.67	0.57	0.82	0.66	0.77	0.70	-0.54	-0.54	0.38
Medication n=35	0.56	0.25	0.55	0.64	0.39	0.33	-0.35	-0.52	0.29

Table 4: Correlations at baseline between KSQ domains and anchors. KSQ: King's Sarcoidosis Questionnaire. GHS: General Health Status. SF-12: Short Form-12. PCS: Physical Component Summary. MCS: Mental Component Summary. K-BILD: King's Brief Interstitial Lung Disease. Tot: Total. Psy: Psychological. BA: Breathlessness and activities. CS: Chest symptoms. MRC: Medical Research Council. FAS: Fatigue assessment scale. FVC: Forced vital capacity.

Table 5

	FVC uq	FVC lq	Mean diff.	FAS lq	FAS uq	Mean diff.	No treatment	Treatment	Mean diff.
GHS	70.6	60.6	9.9 (2.07; 17.8)	81.1	49.5	31.7 (26.4; 36.9)	67.9	58.0	9.9 (4.7; 15.0)
Lung	74.2	58.6	15.6 (9.19; 22.1)	77.6	55.8	21.8 (15.3; 28.4)	68.2	61.8	6.4 (1.0; 11.8)
GHS-Lung	72.5	62.8	9.4 (4.6; 14.8)	77.8	57.2	20.6 (16.7; 24.5)	69.0	62.8	6.2 (2.6; 9.8)

Table 5: GHS, Lung and GHS-Lung scores at baseline for the lower and upper quartile of functional vital capacity (FVC) % of predicted. The lower and upper quartile of FAS score and for non-treated and treated patients. Uq: upper quartile. Lq: lower quartile. Diff: difference

Table 6

	SF-12 domains		K-BILD domains				ΔMRC n=124	ΔFAS n=124	ΔFVC n=128
KSQ domain	ΔMCS n=125	ΔPCS n=125	ΔTot n=125	ΔPsy n=125	ΔBA n=126	ΔCS n=127			
ΔGHS n=128	0.54	0.23	0.54	0.48	0.51	0.42	-0.21	-0.59	0.09
ΔLung n=128	0.48	0.24	0.63	0.47	0.70	0.65	-0.30	-0.53	0.19
ΔGHS Lung n=128	0.53	0.29	0.67	0.55	0.66	0.60	-0.31	-0.61	0.18
ΔMedication n=21	0.29	0.32	0.45	0.47	0.35	0.51	-0.41	-0.36	0.01

Table 6: Correlations between change (Δ)from baseline to 12 months. KSQ: King's Sarcoidosis Questionnaire. GHS: General Health Status. SF-12: Short Form-12. PCS: Physical Component Summary. MCS: Mental Component Summary. K-BILD: King's Brief Interstitial Lung Disease. Tot: Total. Psy: Psychological. BA: Breathlessness and activities. CS: Chest symptoms. MRC: Medical Research Council. FAS: Fatigue assessment scale. FVC: Forced vital capacity. n= number.

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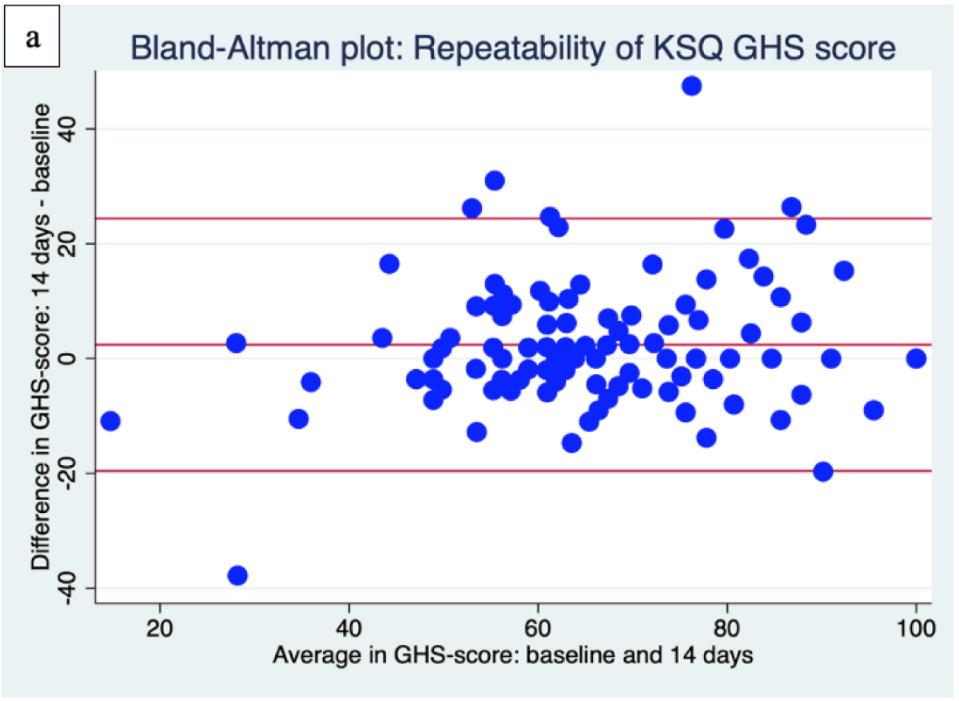

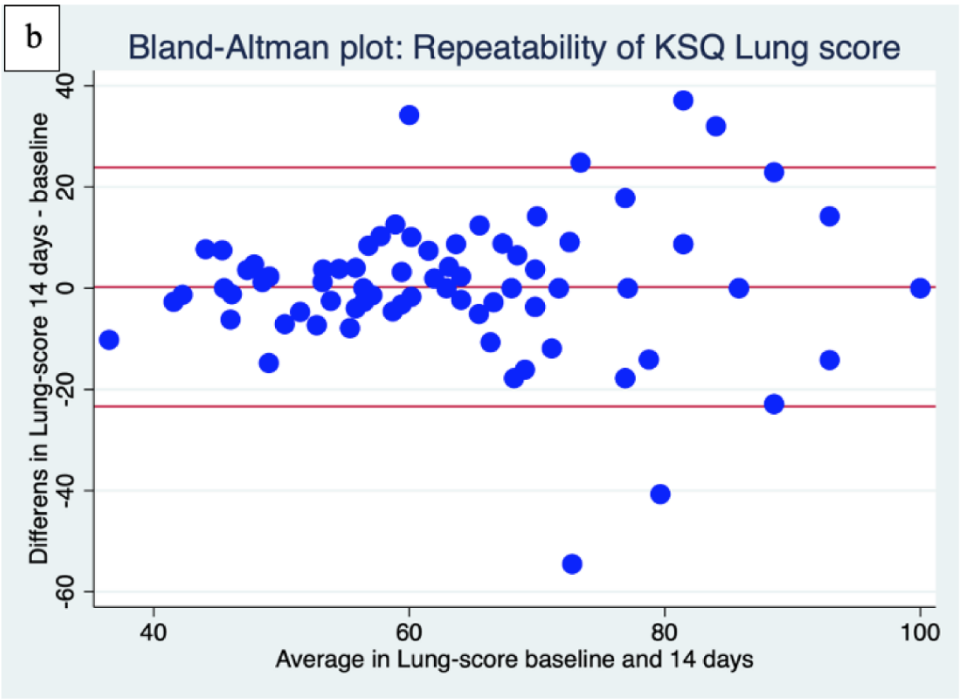

Figure 1. Repeatability of King's Sarcoidosis Questionnaire (KSQ):

a) General Health Status (GHS) and b) Lung scores

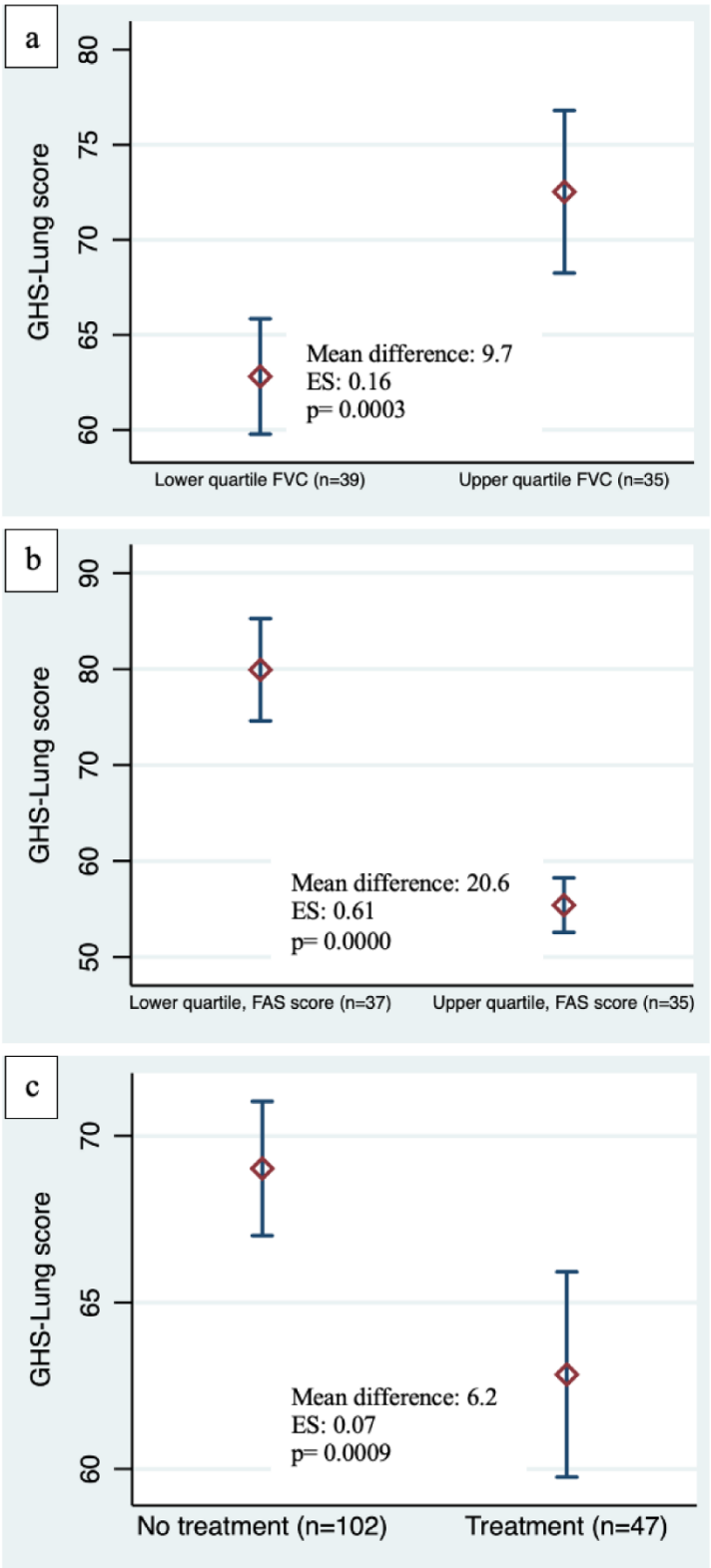

Figure 2: General Health Status-Lung (GHS-Lung) score at baseline in a): the lower and upper quartile of forced vital capacity (FVC) % of predicted, b): the lower and upper quartile of Fatigue assessment scale (FAS) score, c): non treated and treated patients. The dots indicate the median; the lines 95% confidence intervals. N= number. ES: Effect size (partial η^2)