SARCOIDOSIS VASCULITIS AND DIFFUSE LUNG DISEASES 2013; 30; 60-64

The internal consistency of PRO fatigue instruments in sarcoidosis: superiority of the PFI over the FAS

A. Kalkanis[1,2], R.M. Yucel[3], M.A. Judson[1]

[1] Division of Pulmonary and Critical Care Medicine, Albany Medical College, Albany, New York, USA; [2] 3rd Department of Pulmonary Medicine, Sismanoglion Hospital, Athens, Greece; [3] Department of Epidemiology and Biostatistics, School of Public Health, State University of New York at Albany, Rensselaer, NY 12144

Abstract. *Introduction:* The Fatigue Assessment Scale (FAS) is a 10-item patient reported outcome (PRO) questionnaire that is used to measure fatigue in sarcoidosis. After several months of use, we began to question the reliability of the FAS in our clinic population. Therefore, we administered an additional fatigue PRO, the Patient Reported Outcomes Measurement Information Systems (PROMIS) Fatigue Instrument (PFI). Our hypothesis was that the internal consistency/reliability (Cronbach's alpha) of the PFI would be superior to the FAS in sarcoidosis patients because two of the ten FAS items (items #4 and #10) required reverse scoring (these items were scaled in the opposite direction to the other 8 items). *Methods:* The FAS and PFI were administered during the same clinic visit to consecutive patients in our sarcoidosis clinic. We calculated a) the Cronbach's alpha for a) the FAS; b) the FAS without items #4 and #10; and c) the PFI. *Results:* 107 consecutive sarcoidosis patients underwent FAS and PFI testing. The Cronbach's alpha was 0.740, 0.911, and 0.963 for the FAS, FAS with items #4 and #10 removed, and the PFI respectively. In female patients, the Cronbach's alpha of the FAS was 0.663, which is considered as "questionable" in terms of internal consistency. *Conclusion:* We found that the PFI had "excellent" consistency in our sarcoidosis clinic. The FAS did not demonstrate the same degree of internal consistency. The Cronbach's estimate of the FAS with items #4 and #10 removed was vastly superior to the FAS. These data support our contention that FAS items #4 and #10 detract from the internal consistency of this PRO. They also suggest that the PFI is superior to the FAS in terms of reliability. *(Sarcoidosis Vasc Diffuse Lung Dis 2013; 30: 60-64)*

Key words: sarcoidosis, fatigue, Cronbach's alpha, PRO

Introduction

Fatigue is a significant problem for a large percentage of sarcoidosis patients. It is estimated that 60-81% of sarcoidosis patients have significant fatigue (1-3) The cause of fatigue in sarcoidosis is multi-factorial and may relate to inflammatory mediators associated with granulomatous inflammation (4), anti-sarcoidosis therapy, organ dysfunction caused from sarcoidosis, psychological factors including coping with a chronic disease, and factors indirectly related to sarcoidosis such as obesity and sleep apnea (5) related to chronic corticosteroid therapy. Recently, several medications have been suggested to be of benefit for sarcoidosis-associated fatigue (4, 6) Because of this, it is important to identify and monitor fatigue in sarcoidosis patients, iden-

Received: 23 August 2012
Accepted after Revision: 24 January 2013
Correspondence: Marc A. Judson, M.D.;
Division of Pulmonary and Critical Care Medicine;
Albany Medical College, MC-91;
47 new Scotland Avenue, Albany, New York 12208 USA
E-mail: judsonm@mail.amc.edu

tify the causes of fatigue, and to consider anti-fatigue medications in individual cases.

Patient reported outcome (PRO) measures have been developed to quantify the degree of fatigue in patients. A PRO is a measurement of any aspect of a patient's health status that comes directly from the patient (i.e., without the interpretation of the patient's responses by a physician or anyone else) (7). PRO's have the advantage of eliciting the symptoms of fatigue directly from the patient without interpretation by another individual. Furthermore, these tools may be scaled and validated so that these data may reliably reflect the true state of fatigue experienced by these patients (8).

The Fatigue Assessment Scale (FAS) is a 10-item PRO questionnaire that has been validated as an accurate measure of fatigue (9, 10). It has been specifically validated in sarcoidosis and a minimum clinically important difference for this PRO in sarcoidosis has been established (10). For these reasons, measurement of fatigue via the FAS was instituted as the standard of care in our institution's sarcoidosis and pulmonary clinic.

After several months of use, we began to question the validity of the FAS PRO in our clinic population. For that reason, an additional fatigue PRO, the Patient Reported Outcomes Measurement Information Systems (PROMIS) Fatigue Instrument (PFI) (8, 11-14) was also administered to our clinic patients. PROMIS was funded by the National Institutes of Health (NIH) and consists of a system of highly reliable, valid, flexible, precise, and responsive assessment tools that measure patient–reported health status (15).

In this report, we analyze these two PRO fatigue measures in our pulmonary clinic population which contained a high percentage of patients with sarcoidosis. Our hypothesis, based on our anecdotal experience, was that the internal consistency/reliability (Cronbach's alpha) would be superior with the PFI as compared to the FAS.

Methods

This study was approved by the Albany Medical College Institutional Review Board. The study involved administering the FAS and PFI questionnaires, two PRO measures of fatigue, to sarcoidosis patients followed in an outpatient pulmonary clinic of one of the authors (MAJ).

All patients the clinic were eligible to participate if they met the following criteria: a) at least 18 years of age; b) had adequate understanding of English to complete the questionnaires; c) had the mental capability to complete the questionnaire without assistance; d) had sarcoidosis according to standard diagnostic criteria (16, 17). The questionnaires were given to the patients prior the treating physician obtaining a medical history and performance of a physical examination.

Both the FAS and PFI consist of 10 items concerning fatigue that are assessed using a Lickert scale from 1 to 5. In the case of the FAS, the 8 of the 10 items (excluding items #4 and #10) are scored with "1" as the response consistent with the least fatigue and "5" as the response consistent with the most fatigue. For items #4 and #10 of the FAS, they are scored with "5" as the response consistent with the least fatigue and "1" as the response consistent with the most fatigue (item #4 asks about having enough energy with 1=never and 5= always; item #10 asked about concentration ability with 1=never and 5= always). The FAS score sums the scores of all items except of items #4 and #10 and adds the "reverse scores" of items #4 and #10 (i.e., for items #4 and #10, selection "1" is given a score of 5. "2" is given a score of 4, "3" is given a score of 3, "4" is given a score of 2, and "5" is given a score of 1). In the case of the PFI, all items are scored with "1" as the response consistent with the least fatigue and "5" as the response consistent with the most fatigue. The PFI score sums the scores of all items. Both the FAS and PFI yield scores ranging from 10 to 50 where a lower score suggests less fatigue and a higher score suggests more fatigue. The PFI was developed using item response theory (IRT) where a large number of items are scaled in terms of severity of the trait in question (in this case, fatigue) to create an item bank. Items can then be selected from the item bank to create short forms. IRT/item banks allows for the trait in question to be scored by different methods including computer adaptive testing (18), response pattern scoring, and calculating the raw scores by summing the Lickert score of each response. We chose the latter method.

All questionnaires were examined in real time immediately after their completion to check for er-

rors (e.g., failure to answer all items, giving two separate answers to one item, marking a response between two items). All subjects were queried on these occasions and asked to modify their responses. The following demographic and clinical data was obtained: date of birth, gender, race, organ involvement with sarcoidosis (19), date of onset of symptoms related to sarcoidosis.

Statistical computations of means, variances, and Cronbach's alpha were performed using SPSS version 19 software.

Results

The FAS and PFI PROs were administered to a total of 107 sarcoidosis patients at the same clinic visit. The patient demographics and clinical characteristics are displayed in table 1. The overwhelming majority of the patients (92/107, 86%) had biopsy proven sarcoidosis. The remainder had clinical presentations highly specific for sarcoidosis such as Lofgren's syndrome or asymptomatic bilateral hilar adenopathy on a chest radiograph. Table 2 shows the distribution of item scores for the 2 PROs and for the FAS with items #4 and #10 removed. Table 3 shows the Cronbach's Alpha for the 2 PROs and for the FAS with items #4 and #10 removed.

Table 2. Item means ± SD in the fatigue PRO's

	All patients	Male	Female
FAS	2.52 ± 0.574	2.51 ± 0.546	2.52 ± 0.637
FAS -4, -10	2.37 ± 0.536	2.32 ± 0.401	2.42 ± 0.666
PFI	2.70 ± 0.335	2.72 ± 0.316	2.68 ± 0.365

SD: standard deviation; PRO's: patient reported outcome measures; FAS: Fatigue Assessment Scale; FAS -4, -10: Fatigue Assessment Scale with items #4 and #10 removed; PFI: Patient Reported Outcomes Measurement Information Systems (PROMIS) Fatigue Instrument (PFI)

Table 1. Demographics and clinical characteristics of the sarcoidosis cohort (N=107)

Characteristics	Values
Age (mean±SD)	49.5 years ± 10.8
Gender	
Male	52 (49%)
Female	55 (52%)
Race	
White	83 (78%)
Black	24 (23%)
Biopsy proven	92 (86%)
Time from symptom onset to PRO administration (mean±SD, Median)	84 months ± 89.54, 57 months
Time from tissue biopsy to PRO administration (mean±SD, Median)	64 months ± 73.67, 35 months

Organ involvement*	Definite (N)	Probable	(N) Total (N, %)
Lung	93	4	97, 91%
Eye	21	0	21, 20%
Calcium metabolism	8	12	20, 19%
Skin	14	3	17, 16%
Peripheral lymph node	9	2	11, 10%
Neurologic	8	3	11, 10%
Liver	5	6	11, 10%
Heart	9	0	9, 8%
Bone/joint	5	4	9, 8%
Ear, nose, throat	7	0	7, 7%
Spleen	1	6	7, 7%
Parotid	6	0	6, 6%
Muscle	4	0	4, 4%
Bone marrow	3	0	3, 3%

PRO: patient reported outcome measure
* Organ involvement defined by the AACCESS organ assessment instrument (19)

Table 2. Cronbach's alpha of the fatigue PRO's

	All patients	Male	Female
FAS	0.740	0.793	0.663
FAS -4, -10	0.911	0.936	0.874
PFI	0.963	0.964	0.962

PRO's: patient reported outcome measures; FAS: Fatigue Assessment Scale; FAS -4, -10: Fatigue Assessment Scale with items #4 and #10 removed; PFI: Patient Reported Outcomes Measurement Information Systems (PROMIS) Fatigue Instrument (PFI)

Discussion

We found that the PFI was a PRO fatigue measure with very high internal consistency in our sarcoidosis clinic population as determined by the Cronbach's alpha estimate. The Cronbach's alpha estimate was 0.96 for sarcoidosis patients seen in our pulmonary clinic. The following qualitative assessment of the Cronbach's alpha estimate has been suggested; > 0.9 – excellent, > 0.8 – good; > 0.7 - acceptable, > 0.6 - questionable, > 0.5 – poor, < 0.5 unacceptable (20). Using these criteria, the PFI demonstrated excellent internal consistency in our sarcoidosis patients. The FAS did not demonstrate the same degree of internal consistency in our sarcoidosis patients as the Cronbach's alpha estimate was 0.74, which would place it in the acceptable range. In females, the Cronbach's alpha estimate was 0.663, which places the internal consistency of the FAS in the questionable range.

We began to use the PFI as an alternative fatigue PRO in our clinic because anecdotally, we noticed a great deal of potential confusion in our patients using the FAS because of items #4 and #10. The remaining 8 items in the 10-item FAS the patient is asked to grade his level of fatigue with 1 as the least and 5 as the greatest. Conversely, for items #4 and #10 in the FAS, the patient is asked to grade his level of fatigue with 1 as the greatest and 5 as the least. We believed that several of our patients were "conditioned' to answer the items by the time that they reached item #4 so that they responded to this item and item #10 in a manner opposite to the response that they intended. We surmised this because we observed numerous FAS forms where all item responses were either in the "1" to "2" range or the "4" to "5" range. Because of this, we also analyzed the Cronbach's alpha estimate of the FAS PRO after removing items #4 and #10 from the estimate. As we anticipated, the Cronbach's estimate of this "truncated" FAS PRO yielded much higher values of 0.91 for our sarcoidosis clinic patients. These data support our contention that items #4 and #10 in the FAS are often unreliable and detract from the internal consistency of this PRO.

A consideration to improve the FAS would to be to delete items #4 and #10. It should be noted that in a previous analysis of the FAS in a sarcoidosis population, the factor loading of items #4 and #10 ranked eighth out of ten and tenth out of ten of the ten FAS items (21). These results suggest that items #4 and #10 of the FAS do not have major impact on the assessment of fatigue in this PRO, and could possibly be eliminated without significantly impairing the resolution of the instrument. Another manoeuvre that might potentially improve the internal consistency of the FAS would be to change the text display of items #4 and #10. This is based on a standard approach of psychometric test theory that "inversed" items may add to the validity provided that the inversion is clearly visible in the text (e.g. by underlining, italics, bold font).

For a PRO to be clinical useful, it must fulfill various requirements including test-retest reliability, content validity, construct validity, and internal consistency (22). These requirements must be satisfied before the PRO can undergo widespread use in clinical trials and health outcome studies (22). The PFI has met all these requirements whereas we have identified a potential problem with the internal consistency of the FAS.

One advantage of the FAS over the PFI is that it has been extensively studied in sarcoidosis patients including the determination a minimum importance difference in this population (1-3, 9, 10). However, believe that fatigue is most probably not disease-specific. Furthermore the development of the PFI involved field testing of more than ten-thousand subjects which may make this PRO ideal for comparative measurements against other populations. A disadvantage of the FAS compared to the PFI is that the former has never been applied in fatigue assessment in other diseases. This makes comparison of fatigue over different diseases impossible. The PFI, although not disease-specific may allow for sophisticated assessments in different cohorts.

One potential limitation of our study was that it was performed in a specific sarcoidosis population.

Our population contained a higher percentage of Caucasians and fewer African Americans than reported in other US sarcoidosis cohorts (23). Therefore, our results may require confirmation in other sarcoidosis populations. Another potential limitation is that our cohort consisted of a large number of patients who had sarcoidosis for many years. It is possible that these PROs would have displayed different results in patients with predominantly acute or self-limiting disease.

We conclude that although the FAS has been extensively studied as a PRO in sarcoidosis populations, the results of using the FAS in our clinic suggest that it is of borderline internal consistency on the basis of the Cronbach's alpha estimate. From analysis of our data, it appears that the problem with the internal consistency of the FAS involves confusion concerning items #4 and #10 of this PRO. The PFI, although much less studied in this population, appears to have greatly superior internal consistency. These data suggest that the PFI should be considered as a fatigue PRO in sarcoidosis.

References

1. Michielsen HJ, Drent M, Peros-Golubicic T, et al. Fatigue is associated with quality of life in sarcoidosis patients. Chest 2006; 130: 989-94.
2. De Vries J, Rothkrantz-Kos S, van Dieijen-Visser MP, et al. The relationship between fatigue and clinical parameters in pulmonary sarcoidosis. Sarcoidosis Vasc Diffuse Lung Dis 2004; 21: 127-36.
3. Marcellis RG, Lenssen AF, Elfferich MD, et al. Exercise capacity, muscle strength and fatigue in sarcoidosis. Eur Respir J 2011; 38: 628-34.
4. Lower EE, Harman S, Baughman RP. Double-blind, randomized trial of dexmethylphenidate hydrochloride for the treatment of sarcoidosis-associated fatigue. Chest 2008; 133: 1189-95.
5. Drent M, Verbraecken J, van der Grinten C, et al. Fatigue associated with obstructive sleep apnea in a patient with sarcoidosis. Respiration 2000; 67: 337-40.
6. Wagner MT, Marion SD, Judson MA. The effects of fatigue and treatment with methylphenidate on sustained attention in sarcoidosis. Sarcoidosis Vasc Diffuse Lung Dis 2005; 22: 235.
7. Guidance for industry: patient-reported outcome measures: use in medical product development to support labeling claims: draft guidance. Health Qual Life Outcomes 2006; 4: 79.
8. Lai JS, Cella D, Choi S, et al. How item banks and their application can influence measurement practice in rehabilitation medicine: a PROMIS fatigue item bank example. Arch Phys Med Rehabil 2011; 92: S20-27.
9. Michielsen HJ, De Vries J, Van Heck GL. Psychometric qualities of a brief self-rated fatigue measure: The Fatigue Assessment Scale. J Psychosom Res 2003; 54: 345-52.
10. de Kleijn WP, De Vries J, Wijnen PA, et al. Minimal (clinically) important differences for the Fatigue Assessment Scale in sarcoidosis. Respir Med 2011; 105: 1388-95.
11. Cook KF, Bamer AM, Roddey TS, et al. A PROMIS fatigue short form for use by individuals who have multiple sclerosis. Qual Life Res 2011.
12. Christodoulou C, Junghaenel DU, DeWalt DA, et al. Cognitive interviewing in the evaluation of fatigue items: results from the patient-reported outcomes measurement information system (PROMIS). Qual Life Res 2008; 17: 1239-46.
13. Hays RD, Bjorner JB, Revicki DA, et al. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. Qual Life Res 2009; 18: 873-80.
14. Junghaenel DU, Christodoulou C, Lai JS, et al. Demographic correlates of fatigue in the US general population: results from the patient-reported outcomes measurement information system (PROMIS) initiative. J Psychosom Res 2011; 71: 117-23.
15. DeWalt DA, Rothrock N, Yount S, et al. Evaluation of item candidates: the PROMIS qualitative item review. Med Care 2007; 45: S12-21.
16. Judson MA. The diagnosis of sarcoidosis. Clin Chest Med 2008; 29: 415-427, viii.
17. Hunninghake GW, Costabel U, Ando M, et al. ATS/ERS/WASOG statement on sarcoidosis. American Thoracic Society/European Respiratory Society/World Association of Sarcoidosis and other Granulomatous Disorders. Sarcoidosis Vasc Diffuse Lung Dis 1999; 16: 149-73.
18. Lai JS, Cella D, Chang CH, et al. Item banking to improve, shorten and computerize self-reported fatigue: an illustration of steps to create a core item bank from the FACIT-Fatigue Scale. Qual Life Res 2003; 12: 485-501.
19. Judson MA, Baughman RP, Teirstein AS, et al. Defining organ involvement in sarcoidosis: the ACCESS proposed instrument. ACCESS Research Group. A Case Control Etiologic Study of Sarcoidosis. Sarcoidosis Vasc Diffuse Lung Dis 1999; 16: 75-86.
20. George D, Mallery P. SPSS for Windows Step by Step: A simple guide and reference. 11.0 update. 4th ed. Boston: Allyn and Bacon, 2003.
21. De Vries J, Michielsen H, Van Heck GL, et al. Measuring fatigue in sarcoidosis: the Fatigue Assessment Scale (FAS). Br J Health Psychol 2004; 9: 279-91.
22. Hays RD, Revicki D. Reliability and validity (including responsiveness). In: Fayers P, Hays RD, eds. Assessing Quality of Life in Clinical Trials. New York: Oxford University Press, 2005; 25-39.
23. Baughman RP, Teirstein AS, Judson MA, et al. Clinical characteristics of patients in a case control study of sarcoidosis. Am J Respir Crit Care Med 2001; 164: 1885-9.