Published in final edited form as:

Clin Rheumatol. 2015 November ; 34(11): 1929–1937. doi:10.1007/s10067-014-2821-x.

Physical impairment in patients with idiopathic inflammatory myopathies is associated with the American College of Rheumatology Functional Status measure

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Abstract

Objective—The goals of this study were to assess the predictive value of chart abstracted American College of Rheumatology-Functional Status (ACR-FS) with patient reported ACR-FS, and to relate them with measures of muscle function in a single institution cohort of patients with idiopathic inflammatory myopathies (IIMs).

Methods—Demographic and clinical data on 102 patients with IIMs regularly followed in the Rheumatology and Neurology Clinics at the University of Kentucky Medical Center between 2006 and 2012 were obtained through retrospective chart review. Clinical and functional status evaluation, muscle performance testing, and body composition measures were performed on a subset of 21 patients. ACR-FS were obtained both by chart abstraction and direct patient report. Spearman's correlations were used to examine the relationship of ACR-FS derived from chart abstraction with direct patient report, as well as the relationship of measures of physical function and body composition with ACR-FS.

Results—ACR-FS derived from chart abstraction was significantly correlated with ACR-FS derived from direct patient report ($\rho=0.78$, $p<0.001$). ACR-FS derived from chart abstraction was also significantly correlated with patient reported physical function ($\rho=-0.71$, $p<0.001$) and physical activity ($\rho=-0.58$, $p<0.05$), manual muscle testing ($\rho=-0.66$, $p<0.01$) and skeletal muscle

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Author disclosures: Beatriz Y. Hanaoka – none; Laura C. Cleary – none; Douglas E. Long – none; Archana Srinivas – none; Kirk A. Jenkins – none; Heather M. Bush – none; Catherine P. Starnes – none; Mathew Rutledge – none; Jidan Duan – none; Qian Fan – none; Natasha Fraser – none; and Leslie J. Crofford – none.

endurance as measured by the functional index-2 test (shoulder flexion $\rho = -0.62$, $p < 0.01$; hip flexion $\rho = -0.65$, $p < 0.01$; heel lift $\rho = -0.67$, $p < 0.01$; and toe lift $\rho = -0.68$, $p < 0.01$).

Conclusion—The ACR-FS is a simple measure of disability that can be used in chart abstraction studies involving IIM patients. We have demonstrated that ACR-FS correlates well with muscle performance tests of strength and endurance.

Keywords

Idiopathic inflammatory myopathy; functional status; physical function

Introduction

Idiopathic inflammatory myopathies (IIM) are a group of systemic autoimmune diseases that affect skeletal muscle, resulting in proximal muscle weakness, and other extramuscular manifestations that can vary according to disease subtype. IIMs are generally classified as polymyositis (PM), dermatomyositis (DM) and sporadic inclusion body myositis (sIBM). IIMs can also occur in association with malignancies [cancer associated myositis (CAM)] and other connective tissue diseases [overlap myositis (OM)]. Glucocorticoids and immunosuppressive agents, such as methotrexate and azathioprine, are used in the treatment of PM and DM. In spite of treatment, a substantial proportion of patients persist with chronic muscle weakness and disability. Previous studies have identified factors associated with increased disability in patients with PM/DM (i.e., male sex, higher prednisone dosage and presence of glucocorticoid related morbidity) [1-3]. Older age has also been associated with increased muscle weakness in PM/DM.[1] sIBM itself is associated with major end-stage disability [4]. In part due to the rarity of the diseases and difficulties in establishing uniform diagnostic criteria, research has been limited, and the cause of incomplete muscle function recovery still needs to be further clarified. The 1991 revised American College of Rheumatology (ACR) classification criteria of functional status (ACR-FS) in Rheumatoid Arthritis has been used by the International Myositis Assessment and Clinical Studies (IMACS) Group as a measure of the consequences of impairment in patients with IIMs in their clinical data repository form [5,6]. Functional status provides information about daily function (i.e., ability to carry out usual daily self-care activities, including both basic activities of daily living and instrumental activities of daily living), and it is influenced by disease (activity and damage), psychosocial (motivation, coping skills), social (family and community support, economic status and educational level), and environmental factors (geographic location and personal transportation) [7]. Functional status as natural-history and treatment outcome measures is of major concern in IIM. However, studies on the utility of applying the ACR-FS for RA on data derived from chart review of patients with IIM are lacking. Further, the relationships among ACR-FS, patient-reported outcome measures of health and physical activity, and objective measures of muscle strength, endurance and fatigability in IIM are currently unknown and also warrant further investigation.

In this study, we investigated the correlation between ACR-FS derived from chart abstraction with known and suspected risk factors of disability. In a subset of patients, we also studied the correlations among chart abstracted ACR-FS, participant reported current ACR-FS, and objective measures of muscle strength, fatigue and endurance in patients with

IIM. The goals of this study were to assess the predictive value of chart abstracted ACR-FS with patient reported ACR-FS, and to relate them with measures of muscle function in a single institution cohort of patients with idiopathic inflammatory myopathies.

Materials and Methods

Patients with IIM, 18 years of age or older, regularly followed in the Rheumatology and Neurology Clinics at the University of Kentucky Medical Center between 2006 and 2012 were identified using physician service claim diagnosis, provided as International Classification of Diseases, Ninth Revision, clinical modification (ICD-9-CM) codes 710.3, 710.4 and 359.7. In order to increase our specificity of IIM case ascertainment, cohort members were further required to meet inclusion criteria for definite or probable PM/ DM or sIBM according to the Bohan and Peter criteria [8,9] and Griggs' criteria [10], respectively. For OM, cohort members had to meet criteria for their primary connective tissue disease and satisfy probable/ definite criteria for myositis [11]. All experimental procedures were performed in accordance with the University of Kentucky Institutional Review Board. Written informed consent was obtained from each subject prior to participation.

Data collection from clinical record

Demographic and clinical data (i.e., medical history, physical exam findings, laboratory results and medications) were obtained through retrospective chart review using the IMACS Core Patient Data Form [6] by two trained abstractors. In order to establish internal validity, six patient charts were randomly selected and ACR-FS grade was reassessed by the two chart abstractors. There was full concordance between reviewers. Determination of chart-derived ACR-FS grade was based on any comments regarding the patient's ability to completely or partially perform usual self-care activities, vocational and avocational activities. ACR-FS grade was defined as grade I: completely able to perform usual self activities of daily living (self-care, vocational and avocational); grade II: able to perform usual self-care and vocational activities, but limited avocational activities; grade III: able to perform usual self-care activities, but limited in vocational and avocational activities; and grade IV: limited in ability to perform usual self-care, vocational and avocational activities. A thorough review of the entire chart was performed, and in addition to physician notes, notes from other health professionals, including physical and occupational therapists, nursing staff and social workers were also reviewed. Chart-derived ACR-FS was assessed at the end of the observation period (i.e., last visit in chart). Use of oral prednisone, intravenous methylprednisolone, methotrexate, azathioprine, intravenous gamma globulin and tacrolimus by patients with PM, DM and OM during the observation period were recorded as "never" or "current/ ever". Mean prednisone cumulative dose per treatment month was calculated by dividing cumulative prednisone dose (in milligrams) by the number of months the patient was on this medication. Mean cumulative prednisone dose per study month was obtained by dividing the cumulative prednisone dose (in milligrams) by total study observation period in months. Mean daily doses of methotrexate and azathioprine and mean monthly dose of intravenous gamma globulin were reported in milligrams. Disease activity was defined based on the presence of muscle enzyme elevations in the serum (creatinine kinase, aldolase and/or lactic dehydrogenase), characteristic skin signs (Gottron's papules, heliotrope rash) in

patients with DM and the presence of typical clinical symptoms of myositis with involvement of proximal muscles [12]. Disease course was defined as monocyclic, chronic polycyclic or chronic continuous, according to criteria used by Bronner et al. [1]. In cases where the onset of illness was less than 2 years, disease course was classified as undefined. [3] Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Kentucky [13].

Functional study visit

After completion of data collection from the clinical records, all patients were invited to participate in a study visit for an evaluation of clinical and functional status by direct patient report, objective functional assessment, and body composition measurement. Those patients who participated in this study visit comprised the functional study subset of participants. Current ACR-FS was reevaluated, this time taking into account both available clinical data and the participant's own report of their functional status. Participants also underwent manual muscle testing (MMT-8) and muscle endurance testing using the Functional Index-2 (FI-2) [14]. Dual x-ray absorptiometry (DXA) scanning was performed for evaluation of body composition. Frequency, intensity, type, and duration of weekly exercise were assessed using the International Physical Activity Questionnaire (IPAQ) [15]. Participants also completed the Short-Form Health Survey Questionnaire, version 2 (SF-36v2), a widely used tool that measures quality of life, well-being and functional health of general and specific populations, including adult DM, PM and sIBM patients [16].

Strength was measured by determining each subject's maximal voluntary isometric contraction (MVIC) using a dynamometer (Biodex System 4 Quick-Set) after a 5-minute warm up on a semi-recumbent elliptical apparatus (Biostep 1; Biodex) at a comfortable workload and rate. MVIC in the right leg was determined with the subject in a seated position (seat angle at 85°), with the femoral epicondyle aligned to the center of the dynamometer shaft. In order to minimize the use of muscles other than the knee extensors, subjects were stabilized with 2 shoulder straps and a waist strap. Three maximal practice trials were performed, followed by 3 maximal test trials. MVIC (knee at 90°) force was recorded as the highest force generated over 3 trials held for 4 seconds, with a 3-minute rest period between attempts. MVIC force was recorded during a fatigue protocol following strength testing. Participants performed 6 sets of 12 isometric contractions with a 40% duty cycle (4-second contraction and 6-second relaxation); the first set at 20% MVIC, which increased by 10% every set, eventually reaching an intensity of 70% MVIC. Percent loss of MVIC immediately following the fatigue protocol and after 12 minutes of recovery were used as measures of fatigability.

Statistical analysis

All continuous variables were described with means and standard deviations. All categorical variables were described with counts and percents. Comparisons of continuous variables among current ACR-FS grades were made using one-way ANOVAs while comparisons of categorical variables among current ACR-FS grades were made using Fischer's exact tests. Sub-analyses were conducted on a functional study subset of participants. MVIC was normalized to total lean body mass. Spearman's correlations with scatterplots were used to

examine the relationship of selected functional study subset objective measurements with ACR-FS determined by chart abstraction and patient self-report and to examine the relationship between ACR-FS as assessed by retrospective chart abstraction and direct patient self-report. SAS v9.3 was used for all analyses and p -values ≤ 0.05 were considered significant.

Results

Patient Characteristics

All 102 patients whose charts were abstracted were invited to participate in the functional study visit. Of these, fifty four (53%) responded and 21 (21%) completed the study visit. The main reasons for refusal to participate were physical inability and travel distance. Patient characteristics among all subjects and the subset of subjects who participated in the functional study are shown in Table 1. The racial composition of the study group was predominantly white. Among all subjects, the male to female ratio was 1:2; PM was the most frequent clinicopathological subset; and most individuals suffered from some degree of disability (76%). The most frequent disease course was chronic polycyclic. Mean age at diagnosis was significantly higher in PM and sIBM patients (53.2 and 56.6 years, respectively) compared to DM and OM patients (45.9 and 45.7 years, respectively) ($p=0.027$) (not shown in Table 1). Among the patients with OM, there were four cases of systemic sclerosis, three cases of autoimmune hepatitis, two cases of rheumatoid arthritis, two cases of systemic lupus erythematosus, one case of primary biliary cirrhosis, and one case of ankylosing spondylitis. In the functional study visit subset, male sex, older age, longer duration of active disease from diagnosis and the SIBM subtype were more frequently observed compared to all subjects.

ACR Functional Status

ACR-FS grades III and IV were combined for analysis in order to compare patients with substantial functional impairment and those with little or no functional impairment. Patient characteristics by chart-derived ACR-FS grade are shown in Table 2. There was a significant relationship between age and ACR-FS grade. There was a trend for older age at diagnosis to be associated with lower functional status, although this was not statistically significant ($p=0.057$). Older age at the time of assessment was not associated with more impaired functional status. Clinicopathological subset and chart-derived ACR-FS grade were marginally associated ($p=0.0530$). In this regard, while approximately two thirds of patients with DM and OM demonstrated mild or no limitation in their ability to perform daily life tasks, the overwhelming majority of patients with sIBM showed moderate to severe limitation. Although mean duration of active disease from diagnosis was not statistically different between chart-derived ACR-FS grade groups, patients who had some degree of functional impairment tended to have double the time of active disease duration compared to those without any limitation. Patients with chronic continuous and undefined clinical disease courses also tended to have worse functional status.

Clinical characteristics by chart-derived ACR-FS grade

Having at least one extracutaneous extra-muscular manifestation or at least one cutaneous extra-muscular manifestation was not significantly associated with worse ACR-FS grade ($p=0.134$). However, most patients who had arthritis, arrhythmia, dysphonia, dysphagia, interstitial lung disease, calcinosis, cutaneous ulceration or erythroderma had some degree of functional limitation (data can be made available on request). Arrhythmia and dysphagia, in particular, were associated with moderately to severe functional impairment in 66% and 52% of cases, respectively, in our cohort.

Medication use by chart-derived ACR-FS status

Dose was abstracted from charts and was not available for all patients and all medications. Use of azathioprine was significantly related to ACR status ($p=0.014$) with these patients being more likely to be classified as ACR-FS II and less likely to be classified as ACR-FS III/IV. There were no other significant differences in the use of medications according to current ACR-FS grade (data can be made available on request). Intravenous cyclophosphamide treatment was observed in only one out of 82 patients for whom information on this drug use was available. Therefore, intravenous cyclophosphamide was not included in the medication analysis.

Concordance between ACR-FS derived from chart abstraction and direct patient report

ACR-FS grades derived from chart abstraction and current direct patient report were concordant in thirteen out of the twenty one cases analyzed (62%). The major finding of this study was the significant correlation between ACR-FS derived from chart abstraction and direct patient report ($\rho=0.78$, $p<0.001$). Among the thirteen cases where ACR-FS grades by chart abstraction and direct patient report were concordant, there were four cases of DM and sIBM, three cases of OM and 2 cases of PM. Of the eight cases where ACR-FS grades by chart abstraction and direct patient report were discordant, there were three cases each of PM and DM and two cases of sIBM. These results suggest that ACR-FS derived from chart abstraction is a good predictor of functional status across the different IIM histopathological subsets. The maximal time intervals between grading of ACR-FS by chart abstraction and by direct patient report in the concordant and discordant cases were 8.8 and 8.1 months, respectively. In 4 out of the 8 discordant cases, patients reported more functional limitation than what the chart abstractors identified. The difference between ACR-FS derived from chart abstraction and direct patient report was one grade in all but one case, where this difference was two grades. This patient suffered from newly diagnosed PM, and her ACR grade by chart abstraction was II, while by direct patient report it was IV.

ACR-FS and measures of health, physical activity, body composition and muscle function

Another important finding of this study is that both functional status obtained by chart abstraction and by direct patient report significantly correlated with measures of patient reported physical function and activity, and objective measures of muscle strength and endurance, as shown in Table 3. In general, ACR-FS by chart abstraction yielded stronger correlations compared to ACR-FS by direct patient report. Current ACR-FS grade by chart abstraction was negatively correlated with patient reported physical function (SF-36 physical

function $\rho = -0.71$, $p < 0.001$; and SF-36 role-physical, $\rho = -0.64$, $p < 0.01$)) and physical activity (IPAQ total physical activity score $\rho = -0.58$, $p < 0.05$; and IPAQ moderate activity score $\rho = -0.57$, $p < 0.05$); manual muscle testing (total MMT-8 score $\rho = -0.66$, $p < 0.01$), and measures of skeletal muscle endurance as measured by the FI-2 test (shoulder flexion $\rho = -0.62$, $p < 0.01$; hip flexion $\rho = -0.65$, $p < 0.01$; heel lift $\rho = -0.67$, $p < 0.01$; and toe lift $\rho = -0.68$, $p < 0.01$). It is noteworthy that current ACR-FS correlated best with lower extremity portions of the FI-2. In this regard, previous research has shown that performance tests of lower extremity function alone can accurately predict disability across diverse populations [17].

Current ACR-FS by chart abstraction did not significantly correlate with Biodex-derived measures of muscle strength or DXA-derived measures of body composition. Current ACR-FS grade by direct patient report and knee extensor MVIC before and after a fatiguing protocol, as well as DXA-derived total fat and right thigh fat masses were significantly correlated ($p < 0.05$). Patient-reported ACR-FS was not significantly correlated with DXA-derived total or regional mineral free lean masses.

Functional study subset fatiguing protocol

Eighteen out of twenty one study participants (86%) completed the fatiguing exercise protocol. Of the three participants who could not complete this protocol due to profound muscle weakness, two had sIBM and one had PM. These participants were excluded from the analysis. The ACR-FS grade by chart abstraction for all three participants who did not complete the fatiguing protocol was IV, while the current ACR grade by patient report was IV in the two IBM cases and III in the one PM case. Figure 1A illustrates pre, post and recovery MVIC normalized to total lean mass by IIM subtype. Participants with DM and OM had higher pre, post and recovery MVICs compared to PM and sIBM clinicopathological subsets, but this difference was not statistically significant. Figure 1B shows pre, post and recovery MVIC normalized to total lean mass by current ACR-FS by patient report. Pre, post and recovery MVICs clearly distinguished patients with no disability, mild to moderate disability, and severe disability. Pre, post and recovery MVICs were largely reduced in patients with severe functional status impairment, although again this was not statistically significant. Table 3 shows ACR-FS by chart abstraction and direct patient report were not significantly associated with muscle fatigability, as measured by percent fall MVIC. Percent fall MVIC post fatiguing exercises was probably poorly correlated with ACR-FS as a result of a floor effect for patients with severe functional status impairment.

Discussion

We examined ACR-FS obtained by chart abstraction and direct patient report as predictors of disability in a single institution cohort of patients with IIMs. In a subset of patients, we also evaluated the relationship between patient reported physical activity and physical health and muscle performance-based tests and patient reported functional status. The most important finding of this study is that when used as a tool with chart abstraction, the ACR-FS was robustly predictive of directly assessed functional status and physical limitations.

Functional status assessments by chart abstraction and by direct patient report were significantly correlated and concordant in about two thirds of the cases IIM. Further, there did not appear to be a predilection for a specific IIM subset among the concordant and discordant cases. Thus, although IIMs are a heterogeneous group of diseases in terms of pathogenesis, disease course, complications and response to treatment, the ACR-FS appears to be a useful tool to assess functional status across the different subsets. Interestingly, functional status derived by chart abstraction was, in general, more significantly correlated with measures of patient reported health and physical activity and muscle function compared to functional status derived from direct patient report. It is possible that determination of functional status by chart abstraction relies more heavily on descriptors of physical function, while functional status by direct patient report is also influenced by disease, psychosocial, social and environmental factors. We also found that functional status derived from chart abstraction tended to underestimate the degree of functional impairment reported by patients. Previous studies have shown that medical record is a poor source of data on functional status, as it is subject to misclassification bias. This means absence of mention of functional limitations in the records is presumed to indicate functional independence [18]. However, our results suggest chart-derived ACR-FS is significantly associated with measures of physical function, which supports its utility in assessing functional status in patients with IIMs.

Although the focus of poor muscle function in patients with IIMs tends to be on mechanisms intrinsic to muscle such as inflammation and metabolic changes [19], Campbell et al. showed that central fatigue may be more important in patients with IIMs [20]. In that study, patient reported fatigue was not associated with muscle fatigability when it was assessed via transcutaneous direct muscle stimulation. Furthermore, there was no difference in non-volitional quadriceps muscle endurance between IIM patients and healthy controls. In our study, we assessed skeletal muscle strength, fatigue and endurance using volitional techniques. We found poor functional status to be correlated with decreased muscle strength and endurance, but not with muscle fatigability.

As in previous studies, most patients in our cohort suffered from some degree of disability. Older age at diagnosis was marginally predictive of lower functional status. In our study, PM and sIBM clinicopathological subsets also tended to be associated with lower functional status and increased muscle fatigue. Our data demonstrated that 60% of patients with sIBM had ACR-FS grade III/IV by chart abstraction. We also demonstrated a poorer functional outcome in PM compared with DM as patients with PM were almost twice as likely to have ACR-FS grade III/IV than patients with DM (49% vs 29%). These results may be explained in part by the fact that, in our cohort, patients who suffered from PM and sIBM were significantly older at diagnosis compared to patients with DM and OM. These findings also highlight the fact that frailty increases with age. Thus, it is important to readily identify and treat IIM patients who are at increased risk for functional impairment, such as the elderly.

Examples of modifiable risk factors related to age-related frailty that may be prevalent in the IIM population include depression, inadequate dietary intake, nutritional deficiencies and lack of exercise [21,22]. In patients with IIMs, specifically, physical exercise has been reported to have beneficial effects on both muscle performance and disease activity [23]. A

multicenter randomized controlled trial by Alemo Munters et al. showed that a 12-week endurance exercise program increased aerobic capacity, thereby improving health and possibly disease activity in patients with established PM and DM. Also, importantly, the effects of this supervised exercise program on muscle strength were seen up to 1 year [24]. An open study also demonstrated the effectiveness of a 16-week, home exercise program in improving muscle strength and physical activity in patients with sIBM [25].

At present, glucocorticoids remain the cornerstone of therapy in myositis associated with PM, DM and OM. However, immunosuppressive agents, such as methotrexate and azathioprine, are commonly used in patients with refractory disease to reduce the burden of long term glucocorticoid use. It has been previously shown that in IIMs, polyphasic and chronic-progressive disease courses are significantly associated with worse functional outcome [26]. Therefore, it is expected that most patients who require immunosuppressive therapy would have some degree of disability. Although increase in prednisone dosage has been previously linked with higher disability indices as measured by the Health Assessment Questionnaire (HAQ), in our study glucocorticoid use was not significantly associated with functional status [2]. One important weakness of our study is that we obtained information on drug use for all subjects through retrospective chart abstraction, which can produce biased estimates due to missing data. Our study has several other limitations. First, the sample size of the functional study subset is modest, and therefore small or even medium associations may not have been detectable. Second, our study is cross-sectional in nature. Longitudinal studies would be needed to test the ACR-FS sensitivity to change and its ability to predict long-term outcome.

In summary, two main conclusions are drawn from this study. First, the ACR-FS is a simple measure of functional impairment that may be useful in chart abstraction studies involving IIM patients; however, the degree of impairment may be underestimated in some cases. Second, the ACR-FS derived from chart abstraction correlates well with muscle performance tests of strength and endurance, in general.

Acknowledgements

This study was supported by the Clinical to Research Transition Award from the Arthritis Foundation to Dr. Hanaoka. This work was also supported by the University Of Kentucky College Of Medicine Clinician Scholar Award, the Center for Clinical and Translational Science (CCTS) Pilot Award to Dr. Hanaoka, and the CCTS Clinical Services Core (UL1 TR000117). Dr. Bush's work was supported by the University of Kentucky Biostatistics, Epidemiology, and Research Design Consultation service.

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Figure 1A.

Fatiguing protocol: pre, post and recovery MVICs by IIM subtypes

Figure 1B.

Fatiguing protocol: pre, post and recovery MVICs by current direct patient reported ACR-FS

Table 1

Patient Characteristics among all patients and functional study subset patients.

		All Patients (n = 102)	Functional Study Subset (n = 21)
Current Age		56.6 (14.5)	57.6 (16.2)
Age at Diagnosis		50.2 (14.2)	51.2 (13.9)
Duration of active disease from diagnosis (months)		36.1 (45.5)	49.3 (51.1)
Total observation period for prednisone (months) ^a		20.9 (26.0) N = 99	35.2 (27.0) N = 19
Total number of months on prednisone (months) ^a		34.1 (31.2) N = 99	29.0 (32.5) N = 19
Sex	Female	67 (66%)	13 (62%)
	Male	35 (34%)	8 (38%)
Race	White	87 (85%)	19 (91%)
	Non-White	15 (15%)	2 (9%)
Myositis Type	PM	39 (38%)	5 (24%)
	DM	35 (34%)	7 (33%)
	SIBM	15 (15%)	6 (29%)
	OM	13 (13%)	3 (14%)
ACR Current Grade	I	24 (24%)	5 (24%)
	II	35 (34%)	7 (33%)
	III or IV	43 (42%)	9 (43%)
Clinical Course Defined	Monocyclic	12 (11%)	0 (0%)
	Chronic polycyclic	42 (41%)	7 (34%)
	Chronic continuous	19 (19%)	4 (19%)
	Undefined	11 (11%)	11 (47%)

Continuous variables are presented as Means (SD). Categorical variables are presented as Counts (%).

Note: 'Functional Study Subset' subjects are included in 'All Subjects'.

^aPatients who were not treated with prednisone were excluded from the analysis.

Table 2

Patient Characteristics by chart abstracted current ACR-FS grade.

		ACR Current Grade			P-Value
		I (n = 24)	II (n = 35)	III or IV (n = 43)	
Current Age		52.3 (14.5)	56.5 (13.1)	59.0 (15.4)	0.195
Age at Diagnosis		44.8 (14.1)	50.0 (13.6)	53.4 (14.1)	0.057
Duration of active disease from diagnosis (months)		19.0 (19.5)	36.5 (57.6)	44.6 (41.7)	0.174
Total observation period for prednisone (months) ^a		36.9 (22.9) N =23	39.6 (39.7) N =35	27.8 (26.6) N =41	0.243
Total number of months on prednisone (months) ^a		22.6 (22.8) N =23	25.2 (31.9) N =35	16.1 (21.5) N =41	0.296
Sex	Female	18 (27%)	23 (34%)	26 (39%)	0.515
	Male	6 (17%)	12 (34%)	17 (49%)	
Race	White	21 (24%)	31 (36%)	35 (40%)	0.723
	Non-White	3 (20%)	4 (27%)	8 (53%)	
Myositis Type	PM (N =39)	5 (13%)	15 (38%)	19 (49%)	0.074
	DM (N =35)	13 (37%)	12 (34%)	10 (29%)	
	SIBM (N =15)	1 (7%)	5 (33%)	9 (60%)	
	OM (N =13)	5 (38%)	3 (24%)	5 (38%)	
Clinic of Origin	Rheumatology (N =61)	16 (26%)	24 (40%)	21 (34%)	0.158
	Neurology (N =41)	8 (19%)	11 (27%)	22 (54%)	
Clinical Course Defined	Monocyclic (N =12)	6 (50%)	4 (33%)	2 (17%)	0.469
	Chronic polycyclic (N =42)	11 (26%)	15 (36%)	16 (38%)	
	Chronic continuous (N =19)	2 (10%)	6 (32%)	11 (58%)	
	Undefined (N = 29)	5 (17%)	10 (34%)	14 (48%)	

Percents are row percents.

P-values were obtained using Fischer's exact tests for categorical variables and ANOVA for continuous variables.

Continuous variables are presented as Means (SD). Categorical variables are presented as Counts (%).

^aPatients who were not treated with prednisone were excluded from the analysis

Table 3

Correlations of selected measures of health, physical activity, body composition and muscle function with current ACR-FS by chart abstraction and patient report in the functional study subset

Measure	ACR Current Grade, chart abstraction	ACR Current Grade, patient report
<i>IPAQ Total Score</i> (n=21)		
Physical activity	-0.58 *	-0.43
Vigorous activity	-0.37	-0.10
Moderate activity	-0.57 *	-0.53 *
Walking activity	-0.36	-0.28
<i>SF-36 Physical Component (z scores)</i> (n=21)		
Physical function	-0.71 ***	-0.64 **
Role-physical	-0.64 **	-0.38
Bodily Pain	-0.26	-0.10
General Health	-0.44	-0.06
<i>MMT-8 Overall Score (n=21)</i>	-0.66 **	-0.58 **
<i>Biodex</i> (n=18)		
Pre knee extensor MVIC / total lean mass (Nm/ g)	-0.27	-0.45 *
MVIC knee extensor post/total lean mass (Nm/g)	-0.22	-0.54 *
MVIC knee extensor recovery/ total lean mass (Nm/g)	-0.14	-0.43
Percent fall knee extensor MVIC Post	-0.23	-0.31
<i>FI-2 (%maximum)</i> (n=18)		
Shoulder flexion	-0.62 **	-0.12
Shoulder abduction	-0.32	-0.01
Head lift	-0.30	-0.04
Step test	-0.47	-0.27
Hip flexion	-0.65 **	-0.45
Heel lift	-0.67 **	-0.50 *
Toe lift	-0.68 **	-0.51 *
<i>DXA (g)</i> (n=21)		
Total body fat mass	0.24	0.46 *
Total body mineral free lean mass	-0.35	-0.10
Right thigh fat mass	0.34	0.54 *
Right thigh mineral free lean mass	-0.33	-0.15

* p < 0.05.

** p < 0.01,

*** P < 0.001

Note: All correlations are Spearman Correlations

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