Incremental Effects of Comorbidity on Quality of Life in Patients with Psoriatic Arthritis

Janice A. Husted, Arane Thavaneswaran, Vinod Chandran, and Dafna D. Gladman

ABSTRACT. ***Objective.*** To assess the added effect of comorbidity on quality of life (QOL) in psoriatic arthritis (PsA).

Methods. Between 2006 and 2012, 631 patients were recruited from the University of Toronto PsA Clinic. Using the clinical database, we ascertained the frequency of 15 comorbidities. The Medical Outcomes Study Short Form-36 (SF-36) physical (PCS) and mental component (MCS) summary scales were used to assess QOL. Linear regression analyses were conducted to estimate the magnitude of the association between number and type of comorbidities and PCS and MCS scores, after adjustment for disease-related and sociodemographic variables.

Results. Prevalence of comorbidity was high, with 42% of patients having 3 or more comorbid conditions. After adjustment for inflammatory disease–related and sociodemographic factors, a history of 3 or more comorbid conditions accounted for only 2% and 1% of the R^2 value explained in PCS and MCS scores, respectively. In terms of added burden, type of comorbid condition was more significant than number of comorbidities. After adjustment for disease-related and sociodemographic factors, fibromyalgia (FM), neurological disorders, and obesity jointly accounted for 6% of R^2 value explained in PCS scores, while FM and depression/anxiety jointly accounted for about 9% of the R^2 explained in MCS scores. The point decrease in PCS and MCS scores associated with each of these disorders was clinically significant. The 11 other comorbid conditions failed to achieve statistical significance in the models.

Conclusion. The added effect of comorbidity on patient-reported physical and mental health in PsA was more related to type of comorbidity than number of comorbidities. (First Release June 15 2013; J Rheumatol 2013;40:1349–56; doi:10.3899/jrheum.121500)

Key Indexing Terms:
PSORIATIC ARTHRITIS
COMORBIDITY
PATIENT-REPORTED HEALTH
QUALITY OF LIFE

Psoriatic arthritis (PsA) is a chronic inflammatory arthritis associated with psoriasis, usually seronegative for rheumatoid factor[1,2]. Its rheumatic manifestations range from enthesitis, dactylitis, and other extraarticular features typical of the seronegative spondyloarthritides, to spinal involvement and the more debilitating arthritis mutilans. It is a progressive disease that may lead to joint destruction, chronic pain, lost productivity, and reduced quality of life (QOL)[2,3,4,5,6,7,8,9,10,11,12,13,14].

There is increasing recognition that the manifestations of PsA extend beyond the skin and joint disease. In a recent study[15], we found the prevalence of hypertension, obesity, and Type II diabetes was 37.1%, 30.0%, and 12.0%, respectively, higher than observed in the general population, but generally in the range of those reported by other PsA studies[16,17,18,19,20]. Others have shown associations between PsA and other systemic diseases including osteoporosis, cancer, liver disease, and autoimmune disorders[21,22]. Most recently, there is evidence to suggest that PsA, similar to other inflammatory joint diseases, is associated with an increased risk of cardiovascular morbidity and mortality[11,16,17,18,21,23,24,25]. Depressive symptoms have also been reported to be higher in PsA than in population-based samples and unexpectedly higher than in psoriasis, rheumatoid arthritis (RA), and ankylosing spondylitis[4,10,26], possibly because of both inflammatory joint and visible skin involvement[11]. The occurrence of comorbid conditions complicates the question of how a specific disease is related to QOL[27,28,29], and there are limited data on the incremental burden of comorbid conditions on patient outcomes in PsA.

From the Department of Health Studies and Gerontology, University of Waterloo, Waterloo, Ontario; and the Psoriatic Arthritis Program, Centre for Prognosis Studies in the Rheumatic Diseases, University Health Network, Toronto Western Hospital, Toronto, Ontario, Canada.

Supported by grants from The Krembil Foundation and The Arthritis Society. Dr. Chandran was supported by a New Emerging Team grant from the Canadian Institutes of Health Research.

J.A. Husted, PhD, Associate Professor, Department of Health Studies and Gerontology, University of Waterloo; A. Thavaneswaran, MMath, Biostatistician; V. Chandran, MBBS, MD, DM, Assistant Professor; D.D. Gladman, MD, FRCPC, Professor of Medicine, University of Toronto, Senior Scientist, Toronto Western Research Institute, Director, Psoriatic Arthritis Program, Centre for Prognosis Studies in The Rheumatic Diseases, University Health Network, Toronto Western Hospital.

Address correspondence to Dr. D.D. Gladman, Centre for Prognosis Studies in the Rheumatic Diseases, Toronto Western Hospital, 399 Bathurst, 1E-410B, Toronto, Ontario M5T 2S8, Canada. E-mail:dafna.gladman@utoronto.ca

Accepted for publication April 24, 2013.

Understanding the association between comorbidity and QOL may help in effective treatment and management of important patient outcomes in PsA[30,31].

The main purpose of our cross-sectional study was to examine the magnitude of the association between comorbidity and QOL in patients with PsA, adjusting for inflammatory joint and skin disease and relevant sociodemographic characteristics.

MATERIALS AND METHODS

Patient population. The study sample originated from the University of Toronto Psoriatic Arthritis Clinic, established in 1978 to follow patients with PsA prospectively. The clinic serves as primary, secondary, and tertiary referral centers, with a broad spectrum of disease activity and duration. Patients are recruited from several sources, including the phototherapy education and research center and community-based and hospital-based dermatologists, rheumatologists, general internists, and general practitioners in the Toronto area. At the initial visit to the PsA clinic, other forms of arthritis are ruled out. More than 98% of patients fulfill the Classification of Psoriatic Arthritis (CASPAR) criteria for PsA[32,33]. Patients are reevaluated at 6–12 month intervals and each undergoes a complete clinical and laboratory assessment according to a standard protocol; data are entered into a database[3].

Each assessment consists of a detailed medical history, physical examination, and laboratory evaluation including items related to PsA as well as current and past medication history, comorbidities, and known risk factors for PsA. In addition, a number of QOL questionnaires, including the Medical Outcomes Study Short Form-36 Survey (SF-36), are completed by patients on an annual basis.

For this study, we used the same inclusion criteria as for our first comorbidity study[15], including only patients who had been seen at the clinic since 2006. In addition, we use only cross-sectional data from the first clinic visit since 2006 where patients completed the SF-36[34].

Comorbid conditions. At the first clinic visit since 2006, we ascertained the history of 15 comorbid conditions: (1) cardiovascular disease (angina, myocardial infarct, cardiomyopathy, congestive heart failure; cerebrovascular disease); (2) hypertension; (3) hyperlipidemia; (4) type II diabetes; (5) obesity (body mass index ≥ 30); (6) respiratory disease (asthma, chronic obstructive disease, sleep apnea); (7) gastrointestinal disease (ulcer, irritable bowel syndrome); (8) neurological disorder (neuropathy, seizure disorder, multiple sclerosis); (9) liver disease (fatty liver, hepatitis); (10) autoimmune disease (thyroid disease, celiac disease, type I diabetes, Sjögren syndrome, lupus erythematosus); (11) depression/anxiety; (12) cancer; (13) other musculoskeletal conditions, specifically osteoporosis and osteoarthritis; (14) infections; and (15) fibromyalgia (FM). These conditions reflected the current literature on comorbidities in PsA[21,22,35]. The clinical database was used to identify the comorbid conditions in patients. Comorbid conditions were recorded in the database as reported by patients at their initial or subsequent clinic visits, by physical examination, and by use of agents to treat comorbid condition (e.g., antidepressants, antihypertensive, and anxiolytic and lipid-lowering drugs). Additional information was also sought from the patient charts, hospital records, pathology, laboratory or radiography reports, and primary care physicians[23,35].

Clinical and laboratory measures of disease activity and severity. Factors related to disease activity and severity were disease duration, total number of actively inflamed joints (stress pain, joint line tenderness, and/or swelling; scale 0–68); number of clinically deformed joints (ankylosis, subluxation or decreased range of motion > 20%, attributable to joint damage rather than inflammation; scale 0–68); psoriasis severity [Psoriasis Area and Severity Index (PASI), score 0–72][36]; and past and current medications. Laboratory measures included erythrocyte sedimentation rate (ESR) and hemoglobin. Elevated ESR was defined as ESR > 20 mm/h for women and ESR > 15 mm/h for men. Anemia was defined as hemoglobin < 120 g/l for women and < 130 g/l for men.

Sociodemographic variables. A range of variables were assessed including age, ethnicity, education, employment status, sex, daily alcohol use, and current smoking behavior.

Patient-reported physical and mental health. We selected the generic SF-36 questionnaire, developed to assess current physical and mental health functioning across a range of chronic diseases, including arthritis. Specifically, the physical and mental health component scales (PCS and MCS) were used[37]. Both scales are linear combinations of the eight SF-36 subscales, with the PCS heavily weighting the physical functioning, bodily pain, and role disabilities due to physical limitations subscales; and the MCS heavily weighting the mental health, social functioning, and role disabilities-emotional limitations subscales. The PCS and MCS scores were adjusted by the general US population and SD to produce norm-based scores with a population mean of 50 (SD 10)[37]. Scores below 50 reflected below-average functioning, with very low PCS scores reflecting severe bodily pain and substantial limitations in self-care, physical activities, and role performance; and very low MCS scores indicating frequent psychological distress and role disability due to emotional problems[37]. The SF-36 has been shown to be reliable in our clinic population[38].

The study was approved by the Research Ethics Board at the University Health Network.

Analyses. Descriptive information was provided on the 631 patients at their first SF-36 assessment since 2006. Initially, univariate linear regression analyses were performed to investigate separately the cross-sectional associations of PCS and MCS scores with number of comorbid conditions, disease activity and severity, and sociodemographic variables. Tests for linearity indicated there was a nonlinear relationship between number of comorbid conditions and MCS and PCS scores. We therefore recoded a number of comorbid conditions to reflect the presence or absence of history of 3 or more comorbid conditions (0 = less than 3 comorbid conditions and 1 = 3 or more comorbid conditions). In the multivariate regression analyses we used a stepwise procedure, with forced entry of age, sex (males vs females), and PsA duration (step 1). The remaining variables with p values below the 0.05 significance level were then considered for both inclusion and retention in the multivariate linear regression analyses. R^2 values were used to estimate the strength of the association between PCS and MCS scores and comorbid conditions, PsA status, and sociodemographic variables. In the univariate analysis shown in Table 3, R^2 values denoted the proportion of the total variance in PCS and MCS scores explained or accounted for by the variable in the regression equation. In the multivariate analysis (Tables 4 and 5), multiple R^2 values indicated the proportion of the total variance in PCS and MCS scores explained by all variables in the final regression equation, while the incremental change in R^2 value denoted the proportion of the total variance in PCS and MCS scores explained or accounted for by each of the variables in the final regression equation. We also examined interactions of our derived comorbidity index with age, sex, disease activity and severity, as measured by elevated ESR, severe psoriasis (PASI score > 10), number of actively inflamed joints, and severe clinical deformity (damaged joints ≥ 5). Finally, we repeated these analyses jointly, entering the specific comorbid conditions in place of the derived comorbidity index. Statistical analyses were performed using SAS 9.2 software.

RESULTS

Included in the study was a group of 631 patients, predominantly male and white, with PsA (Table 1). The mean age and mean disease duration were 49.6 years (SD 12.9) and 13.0 years (SD 10.8), respectively. The mean number of actively inflamed joints and clinically deformed joints (9.4 and 12.8) reflected moderate to severe disease activity and damage. Thirteen percent of patients had a history of severe

Table 1. Sociodemographic and disease characteristics of 631 patients with psoriatic arthritis (PsA) at SF-36 assessment.

Variables	Frequency (%) or Mean (± SD)
Males (%)	370 (58.6)
Age, yrs	49.6 (12.9)
White (%)	551 (88.3)
College or university education (%)	463 (74.8)
Employed or fulltime student (%)	424 (67.2)
Married or common-law (%)	424 (67.2)
Current smokers (%)	75 (11.9)
Current daily drinkers (%)	40 (6.4)
Duration of PsA, yrs	13.0 (10.8)
Severe psoriasis (PASI > 10; %)	76 (12.5)
No. actively inflamed joints	9.4 (9.7)
Severe clinical deformity (≥ 5 deformed joints; %)	215 (61.6)
No. with elevated ESR (%)	200 (32.2)
No. with anemia* (%)	82 (13.2)
NSAID ever used	539 (85.4)
DMARD ever used	455 (72.1)
Biologic agents ever used	165 (25.8)
No. comorbidities	2.5 (2.1)
No. with 3 or more comorbidities (%)	266 (42.2)
SF-36 PCS	37.4 (11.1)
SF-36 MCS	45.7 (11.6)

* Anemia: hemoglobin < 130 g/l for men and < 120 g/l for women. SF-36: Medical Outcomes Study Short Form-36; PASI: Psoriasis Area and Severity Index; ESR: erythrocyte sedimentation rate; elevated ESR: > 15 mm/h for men, > 20 mm/h for women; NSAID: nonsteroidal antiinflammatory drugs; DMARD: disease-modifying antirheumatic drugs; PCS: physical health component scale of SF-36; MCS: mental health component scale of SF-36.

psoriasis. The mean number of comorbid conditions was 2.5 (SD 2.1, range 0–11), with 42.2% of the sample having a current or past history of 3 or more comorbidities. The mean PCS score of 37.4 and mean MCS score of 45.7 indicated frequent pain, considerable physical limitations, psychological distress, and role disability because of physical and emotional problems.

Table 2 shows that patients with 3 or more comorbid conditions had lower PCS and MCS scores (reflecting poorer health). The 6-point difference in mean PCS scores between patients with 3 or more conditions and those with fewer than 3 comorbid conditions exceeded the minimum clinically important difference (MCID) for the SF-36, considered to be in the range of 3–5 points[39,40]. Additional analyses indicated that patients with 3 or more comorbidities were more likely to be women ($p = 0.002$), to be older ($p < 0.0001$), and to have a longer illness duration ($p < 0.0001$). Table 2 also shows that mean PCS scores were lowest in patients with FM (score 28.4) and neurological disease (primarily neuropathies; score 33.8), while MCS scores were lowest in PsA patients with FM (40.6) and depression/anxiety (41.1).

Results of univariate relationships among sociodemographic variables, disease status, comorbidity, and patient-reported physical and mental health. Table 3 shows that the majority of variables were significantly associated with physical health, as measured by the PCS. Males and patients with university or college education were more likely to report higher PCS scores (or better physical health). Married patients and those who were currently employed were also more likely to report higher PCS scores, as were daily alcohol drinkers. Smokers reported lower PCS scores. Clinical and laboratory measures of disease activity and severity (including medication ever used), as well as a history of 3 or more comorbid conditions, were associated with decreasing levels of physical health (or lower PCS scores). Based on R^2 values, employment status, number of actively inflamed joints, and 3 or more comorbidities were the most strongly associated with level of physical functioning (R^2 = 9.0%, 16.0%, and 5.0%, respectively). While data are not shown, the following 9 comorbid conditions were significantly associated ($p < 0.05$ level) with decreased levels of physical health: cardiovascular disease, hypertension, type II diabetes, obesity, respiratory disease, neurological disease, depression/anxiety, cancer, and FM. Based on the R^2 values, FM and obesity were the most strongly associated with level of physical health (R^2 = 11.0% and 3.0%, respectively).

Fewer sociodemographic and disease-related variables were significantly associated with MCS scores. Only number of actively inflamed joints and biological agents ever used were associated with lower MCS scores, whereas number of deformed joints and illness duration were associated with higher scores. A history of 3 or more comorbid conditions was also associated with lower MCS scores. Based on R^2 values, number of actively inflamed joints was the most strongly associated with level of mental functioning (R^2 = 3.0%). Depression/anxiety and FM were the only comorbid conditions to be significantly associated with levels of mental health (R^2 = 9% and 5%, respectively; data not shown).

Results of multivariate relationships among sociodemographic variables, disease status, number or type of comorbid conditions, and patient-reported physical and mental health. Table 4 shows the added influence of 3 or more comorbidities on both physical and mental health. As shown, the stepwise model for physical and for mental health explained 29% and 9% of the variance in PCS and MCS scores, respectively. Note that the multivariate analyses used a stepwise procedure, with the first step being forced insertion of age, sex, and PsA duration into the models. The p values for all remaining variables in both stepwise models were below the 0.05 significance level. A history of 3 or more comorbid conditions accounted for only 2% and 1% of the R^2 explained in PCS and MCS scores, respectively, after adjustment for disease status and sociodemographic influences. Number of actively inflamed joints played the largest role in accounting for R^2 explained in

Table 2. Relationship between number and type of comorbid conditions and physical and mental health status.

No. Comorbid Conditions	Count (%)	Mean (SD) PCS	Mean (SD) MCS
< 3	365 (57.8)	42.2 (11.2)	48.5 (10.7)
≥ 3	266 (42.2)	36.8 (12.1)	46.4 (11.3)
Type of comorbidity			
Cardiovascular disease*	48 (7.6)	34.4 (13.0)	46.2 (10.9)
Hypertension	221 (35.0)	37.1 (12.1)	47.2 (10.8)
Hyperlipidemia	124 (19.7)	37.2 (10.8)	43.9 (10.6)
Type II diabetes	72 (11.4)	35.4 (11.7)	46.4 (11.6)
Obesity	204 (32.3)	37.2 (11.9)	46.6 (11.5)
Respiratory disease*	70 (11.1)	36.4 (11.8)	45.7 (11.6)
Gastrointestinal disease*	37 (5.9)	37.7 (14.2)	47.1 (10.7)
Neurological disease*	49 (7.8)	33.8 (11.5)	47.0 (10.6)
Autoimmune disease*	55 (8.7)	37.5 (11.5)	46.9 (10.4)
Liver disease*	15 (2.4)	35.1 (10.7)	45.2 (12.5)
Depression/anxiety	130 (20.6)	37.0 (12.4)	41.1 (11.8)
Cancer	56 (8.9)	34.8 (11.7)	45.9 (11.3)
Other musculoskeletal conditions*	377 (59.7)	39.4 (11.8)	47.6 (11.0)
Infection	216 (34.2)	39.6 (12.2)	48.0 (10.6)
Fibromyalgia	139 (22.0)	28.4 (10.7)	40.6 (12.0)

* Cardiovascular: angina, myocardial infarction, cardiomyopathy, congestive heart failure, and cerebrovascular accident; respiratory disease: asthma, chronic obstructive lung disease, and sleep apnea; gastrointestinal: ulcer and irritable bowel syndrome; neurological disorder: neuropathy, seizure disorder, and multiple sclerosis; autoimmune disease: thyroid disease, celiac disease, type I diabetes, Sjögren syndrome, and lupus erythematosus; liver disease: fatty liver and hepatitis; other musculoskeletal conditions: osteoporosis, osteoarthritis. PCS: physical health component scale of SF-36; MCS: mental health component scale of SF-36; SF-36: Medical Outcomes Study Short Form-36.

PCS scores (16.2%) and in MCS scores (3.0%). The multivariate regression analyses that included interaction terms produced no statistically significant interaction effects, and therefore only main effects of the study variables were included in the multivariate models.

Table 5 shows the results of the multivariate models that jointly entered the specific conditions in place of a history of 3 or more comorbid conditions. As shown, the stepwise model for physical and for mental health now explained 31.5% and 15.5% of the variance in PCS and MCS scores,

Table 3. Results for univariate linear regression analysis of physical and mental health on sociodemographic characteristics, disease status, and number of comorbid conditions.

Variables	PCS B	PCS SE	PCS p	PCS R^2	MCS B	MCS SE	MCS p	MCS R^2
Sex (male vs female)	3.65	0.95	0.0001	0.02	0.83	0.89	0.35	0.006
Age	–0.06	0.04	0.10	0.004	0.03	0.03	0.31	0.002
White (yes vs no)	0.008	0.03	0.78	0.0001	0.94	1.37	0.49	0.0008
College or university education (yes vs no)	3.61	1.10	0.001	0.02	2.75	1.01	0.007	0.01
Employed (yes vs no)	7.71	0.9	< 0.0001	0.09	3.18	0.93	0.0007	0.02
Married (yes vs no)	0.66	1.17	0.58	0.0005	0.40	1.09	0.71	0.0002
Current smoker (yes vs no)	–1.73	0.56	0.002	0.02	–1.95	0.51	0.0002	0.02
Current daily drinker (yes vs no)	2.66	0.79	0.0009	0.02	0.57	0.74	0.44	0.001
Duration of PsA (yrs)	–0.07	0.04	0.12	0.004	0.10	0.04	0.01	0.01
Severe psoriasis (PASI > 10)	–2.95	1.47	0.04	0.007	0.005	1.35	0.10	0.000
No. actively inflamed joints	–0.53	0.05	< 0.0001	0.16	–0.21	0.05	< 0.0001	0.03
Severe clinical deformity (≥ 5 deformed joints)	–0.80	1.00	0.42	0.001	2.11	0.92	0.02	0.008
Elevated ESR (yes vs no)	–3.97	1.02	0.0001	0.02	–1.20	0.94	0.20	0.003
Anemia (yes vs no)	–4.58	1.41	0.001	0.02	0.25	1.30	0.85	0.0001
NSAID ever used (yes vs no)	–2.77	1.34	0.04	0.007	1.81	1.24	0.15	0.003
DMARD ever used (yes vs no)	–2.81	1.05	0.008	0.01	0.37	0.98	0.70	0.0002
Biologic agents ever used (yes vs no)	–3.16	1.08	0.004	0.01	–2.13	1.00	0.03	0.007
Three or more comorbid conditions (yes vs no)	–5.42	0.94	< 0.0001	0.05	–2.0	0.88	0.008	0.02

See Table 1 for definitions. SE: standard error.

Table 4. Results for stepwise multivariate linear regression analyses of physical and mental health on sociodemographic characteristics, disease status, and number of comorbid conditions.

	PCS			
Variables	Estimate	SE	p	Incremental Change in R^2
Intercept	37.33	3.32	< 0.0001	—
Sex	1.56	0.89	0.08	
Age	0.07	0.04	0.08	0.03*
Duration of PsA	–0.04	0.05	0.434	
No. actively inflamed joints	–0.45	0.05	< 0.0001	0.16
Employed	4.31	1.09	< 0.0001	0.04
Three or more comorbid conditions	–4.91	1.00	< 0.0001	0.02
Elevated ESR	–2.51	0.95	0.009	0.01
Biologic agents ever used	–2.08	1.00	0.038	0.006
College or university education	2.32	1.01	0.02	0.006
Current smoker	–1.19	0.52	0.02	0.005
NSAID ever used	–2.74	1.30	0.04	0.005
Anemia	–2.63	1.32	0.05	0.005
Multiple $R^2 = 0.29$				
Adjusted $R^2 = 0.28$				
No. observations deleted due to missing data = 55				

	MCS			
Variables	Estimate	SE	p	Incremental Change in R^2
Intercept	40.35	3.17	< 0.0001	—
Sex	–0.21	0.89	0.81	
Age	0.09	0.04	0.04	0.01*
Duration of PsA	0.08	0.05	0.07	
No. actively inflamed joints	–0.14	0.05	0.003	0.03
Employed	2.40	1.08	0.03	0.02
Current smoker	–1.60	0.52	0.002	0.01
Three or more comorbid conditions	–2.84	1.00	0.005	0.01
College or university education	2.09	1.01	0.04	0.007
Multiple $R^2 = 0.09$				
Adjusted $R^2 = 0.08$				
No. observations deleted due to missing data = 29				

See Table 1 for definitions. * Incremental change in R^2 for step 1 of multivariate analyses that forced entry of sex, age, and duration of PsA. SE: standard error.

respectively. Again, number of actively inflamed joints played the largest part in accounting for R^2 explained in PCS scores (16.0%). However, FM, neurological disorders, and obesity taken together accounted for about 6% of R^2 explained in PCS scores. Number of actively inflamed joints accounted for 2% of R^2 explained in MCS scores, whereas depression/anxiety and FM combined accounted for about 8% of the R^2 explained in MCS scores. Because of relatively small numbers of individual comorbidities, multivariate regression analyses including interaction terms were not conducted.

DISCUSSION

To our knowledge this the first study to estimate the added burden of comorbidity on patient-reported health in PsA. As expected, the prevalence of comorbidity was relatively high in our clinic sample of 631 patients, with 42% having 3 or more comorbid conditions. At the univariate level, a history of 3 or more comorbid conditions was significantly associated with physical health, explaining 5% of the explained variance in PCS scores. However, after adjustment for effects of inflammatory disease-related and sociodemographic characteristics, the association between 3 or more comorbid conditions and PCS scores explained only 2% of the explained variance in PCS scores. Number of actively inflamed joints played the largest role in accounting for R^2 explained in PCS scores (16.2%). In the univariate and multivariate analyses, 3 or more comorbid conditions explained only 2% and 1% of the explained variance in MCS scores, respectively.

More importantly, our results indicated that not all comorbid conditions were associated with levels of physical and mental health. This suggested that a simple count of conditions (which assumes equal influence of each

Table 5. Results for the stepwise multivariate linear regression analyses of physical and mental health on sociodemographic characteristics, disease status, and individual comorbid conditions.

	PCS			
Variables	B	SE	p	Incremental Change in R^2
Intercept	38.94	3.40	< 0.0001	
Sex	1.31	0.93	0.16	
Age	0.007	0.04	0.86	0.03*
Duration of PsA	0.009	0.05	0.86	
No. actively inflamed joints	–0.41	0.05	< 0.0001	0.16
Employed	4.52	1.10	< 0.0001	0.04
Fibromyalgia	–6.50	1.62	< 0.0001	0.03
Neurological disorder	–6.03	1.58	0.0002	0.02
NSAID ever used	–3.57	1.31	0.007	0.01
College or university education	–2.31	1.04	0.03	0.01
Obesity	–2.43	0.96	0.01	0.007
Anemia	–3.27	1.31	0.01	0.008
Multiple R^2 = 0.33				
Adjusted R^2 = 0.31				
No. observations deleted due to missing data = 102				

	MCS			
Variables	B	SE	p	Incremental Change in R^2
Intercept	45.22	3.03	< 0.0001	
Sex	–0.95	0.91	0.30	
Age	0.04	0.04	0.33	0.01*
Duration of PsA	0.07	0.05	0.14	
Depression, anxiety	–7.20	1.11	< 0.0001	0.08
Current smoker	–1.77	0.52	0.0008	0.02
No. actively inflamed joints	–0.12	0.05	< 0.01	0.02
College or university education	2.89	1.01	0.005	0.01
Fibromyalgia	–4.12	1.58	0.01	0.01
Multiple R^2 = 0.15				
Adjusted R^2 = 0.14				
No. observations deleted due to missing data = 60				

See Table 1 for definitions. * Incremental change in R^2 for step 1 of multivariate analyses that forced entry of sex, age, and duration of PsA. SE: standard error.

condition) may underestimate the effects of specific comorbidities[40]. Indeed, in the multivariate models that jointly entered the individual comorbidities (Table 5), the joint explanatory power of comorbidities increased. Taken together, FM, obesity, and neurological disorders (primarily neuropathies) explained about 6% of the explained variance in PCS scores, and depression/anxiety and FM explained about 9% of the explained variance in MCS scores. With the exception of obesity, the magnitude of the decrease in PCS or MCS scores associated with each of these conditions (as well as anemia) exceeded the MCID.

Our findings show some consistency with studies that have investigated the effects of comorbidity on patient-reported health in other chronic diseases. Rijken, *et al*[27] investigated the effect of comorbidity on cardiovascular disease, arthritis, cancer, diabetes, chronic respiratory diseases, and thyroid disease, and found that arthritis affected physical function (as measured by the SF-36 PCS) more than all other conditions studied, regardless of the presence of coexisting comorbidity. This is consistent with our observation that the number of actively inflamed joints played the largest role in explaining the variance in physical health in our sample of PsA patients. Similar to our findings, arthritis and the other physical conditions were unrelated or weakly related to mental health (as measured by the SF-36 MCS). Rijken, *et al*[27] argued that unmeasured disease characteristics, such as illness duration and disease stage, may be more important for mental health than the type and number of chronic physical conditions. However, we found that PsA duration and number of clinically deformed joints were unrelated to mental health status at the multivariate level. Rather, the type and number of coexisting mental conditions (e.g., depression) and other chronic pain disorders (e.g., FM) may be more important[37,41]. Rupp, *et al*[40] also investigated the effect of comorbidity on health-related QOL, but in patients with RA, and found that

its effect varied by the outcome studied (physical vs mental) and by type of comorbidity, concluding that a summary count of comorbidity likely masks true effects. Future research should investigate the added influence of comorbidity on the full range of important patient outcomes in PsA, including work disability, hospitalization, and premature mortality. We focused solely on patient-reported physical and mental health. In addition, we did not study the entire range of comorbidities such as chronic pain disorders[41] and visual and hearing impairments shown to be related to both physical and mental health[37].

There are further methodological issues that warrant consideration. Our study patients may not be representative of all patients with PsA. To address this, we compared sociodemographic characteristics, disease features, and selected comorbidities in our patients with PsA to others reported in the literature[16,17,18,19,20,42] and found they were quite similar, although our patients achieved a higher level of education. However, because our patients are routinely seen at the clinic every 6–12 months, the effects of comorbidities may be minimized owing to early detection and effective treatment. In addition, small numbers prevented examination of the effects of particular combinations of comorbid conditions[28,40]. Further, the different timeframe for assessment of comorbid conditions (past and current) and physical and mental health (current) could have led to an underestimate of the cross-sectional association between specific comorbid conditions and physical and mental health, because some conditions may be successively treated (e.g., cancer, cardiovascular disease), and others (depression or anxiety) may have gone undetected or untreated[29]. Finally, because this was a cross-sectional study, we could not determine whether the individual comorbid conditions most associated with physical or mental health (e.g., obesity, neuropathies, FM) antedated the onset of PsA, or were a consequence of the disorder and its treatment. If the latter, we may have overestimated their influence relative to that of inflammatory joint disease.

There are limited data on the added burden of comorbidity on patient outcomes in PsA. Overall, our results suggested that type of comorbid condition was more important than the total number of conditions. Of the comorbidities studied, FM, neurological disorders, and obesity were most strongly associated with decreased physical health, after adjustment for inflammatory disease-related and sociodemographic characteristics. FM and depression/anxiety disorders were most strongly associated with decreased mental health. Our results suggest that management of PsA likely extends beyond treatment of the inflammatory joint and skin disease. To optimize important patient outcomes, physicians should consider patient education, counseling, or referral to specialists in the areas of weight management, mobility, pain control, and psychological distress.

ACKNOWLEDGMENT

The authors thank the patients for their participation in the study, Renise Ayearst for data management, and Maria Morales for assistance in preparation of the manuscript.

REFERENCES

1. Gladman DD. Psoriatic arthritis. In: Harris ED, Budd RC, Firestein GS, Genovese MC, Sergent JS, Ruddy S, et al, editors. Kelly's textbook of rheumatology. 7th ed. Philadelphia: W.B. Saunders Co.; 2004:1155-64.
2. Dhir V, Aggarwal A. Psoriatic arthritis: a critical review. Clin Rev Allerg Immunol 2013;44:141-8.
3. Gladman DD, Shuckett R, Russell ML, Thorne JC, Schachter RK. Psoriatic arthritis (PSA) — an analysis of 220 patients. Q J Med 1987;62:127-41.
4. Husted JA, Gladman DD, Farewell VT, Cook RJ. Health-related quality of life of patients with psoriatic arthritis: a comparison with patients with rheumatoid arthritis. Arthritis Rheum 2001;45:151-8.
5. Kane D, Stafford L, Bresnihan B, Fitzgerald O. A prospective, clinical and radiological study of early psoriatic arthritis: an early synovitis clinic experience. Rheumatology 2003;42:1460-8.
6. McHugh NJ, Balachrishnan C, Jones SM. Progression of peripheral joint disease in psoriatic arthritis: a 5-yr prospective study. Rheumatology 2003;42:778-83.
7. Queiro-Silva R, Torre-Alonso JC, Tinture-Eguren T, Lopez-Lagunas I. A polyarticular onset predicts erosive and deforming disease in psoriatic arthritis. Ann Rheum Dis 2003;62:68-70.
8. Sokoll KB, Helliwell PS. Comparison of disability and quality of life in rheumatoid and psoriatic arthritis. J Rheumatol 2001;28:1842-6.
9. Borman P, Toy GG, Babaoglu S, Bodur H, Ciliz D, Alli N. A comparative evaluation of quality of life and life satisfaction in patients with psoriatic and rheumatoid arthritis. Clin Rheumatol 2007;26:330-4.
10. Salaffi F, Carotti M, Gasparini S, Intorcia M, Grassi W. The health-related quality of life in rheumatoid arthritis, ankylosing spondylitis, and psoriatic arthritis: a comparison with a selected sample of healthy people. Health Qual Life Outcomes 2009;7:25.
11. Lee S, Mendelsohn A, Sarnes E. The burden of psoriatic arthritis: a literature review from a global health systems perspective. Pharm Therapeut 2010;35:680-9.
12. Wallenius M, Skomsvoll JF, Koldingsnes W, Rodevand E, Mikkelsen K, Kaufmann C, et al. Work disability and health-related quality of life in males and females with psoriatic arthritis. Ann Rheum Dis 2009;68:685-9.
13. Zachariae H, Zachariae R, Blomqvist K, Davidsson S, Molin L, Mork C, et al. Quality of life and prevalence of arthritis reported by 5,795 members of the Nordic Psoriasis Associations. Data from the Nordic Quality of Life Study. Acta Derm Venereol 2002;82:108-13.
14. Hu SW, Holt EW, Husni ME, Qureshi AA. Willingness-to-pay preferences for 8 health-related quality-of-life domains in psoriatic arthritis: a pilot study. Semin Arthritis Rheum 2010;39:384-97.
15. Husted JA, Thavaneswaran A, Chandran V, Eder L, Rosen CF, Cook RJ, et al. Cardiovascular and other comorbidities in patients with psoriatic arthritis: a comparison with patients with psoriasis. Arthritis Care Res 2011;63:1729-35.
16. Kimhi O, Caspi D, Bornstein NM, Maharshak N, Gur A, Arbel Y, et al. Prevalence and risk factors of atherosclerosis in patients with psoriatic arthritis. Semin Arthritis Rheum 2007;36:203-9.
17. Tam LS, Tomlinson B, Chu TT, Leung YY, Kwok LW, Li TK, et al. Cardiovascular risk profile of patients with psoriatic arthritis compared to controls — the role of inflammation. Rheumatology 2008;47:718-23.
18. Han C, Robinson DW Jr, Hackett MV, Paramore LC, Fraeman KH,

Bala MV. Cardiovascular disease and risk factors in patients with rheumatoid arthritis, psoriatic arthritis, and ankylosing spondylitis. J Rheumatol 2006;33:2167-72.
19. Ciocon DH, Horn EJ, Kimball AB. Quality of life and treatment satisfaction among patients with psoriasis and psoriatic arthritis and patients with psoriasis only: results of the 2005 Spring US National Psoriasis Foundation Survey. Am J Clin Dermatol 2008;9:111-7.
20. Christophers E, Barker JN, Griffiths CE, Dauden E, Milligan G, Molta C, et al. The risk of psoriatic arthritis remains constant following initial diagnosis of psoriasis among patients seen in European dermatology clinics. J Eur Acad Dermatol Venereol 2010;24:548-54.
21. Husni ME, Mease PJ. Managing comorbid disease in patients with psoriatic arthritis. Curr Rheumatol Rep 2010;12:281-7.
22. Kimball AB, Gladman DD, Gelfand JM, Gordon K, Horn EJ, Korman NJ, et al. National Psoriasis Foundation clinical consensus on psoriasis comorbidities and recommendations for screening. J Am Acad Dermatol 2008;58:1031-42.
23. Gladman DD, Ang M, Su L, Tom BD, Schentag CT, Farewell VT. Cardiovascular morbidity in psoriatic arthritis. Ann Rheum Dis 2009;68:1131-5.
24. Peters MJ, van der Horst-Bruinsma IE, Dijkmans BA, Nurmohamed MT. Cardiovascular risk profile of patients with spondylarthropathies, particularly ankylosing spondylitis and psoriatic arthritis. Semin Arthritis Rheum 2004;34:585-92.
25. Ahlehoff O, Gislason GH, Charlot M, Jorgensen CH, Lindhardsen J, Olesen JB, et al. Psoriasis is associated with clinically significant cardiovascular risk: a Danish nationwide cohort study. J Intern Med 2011;270:147-57.
26. Kimball AB, Bensimon AG, Guerin A, Yu AP, Wu EQ, Okun MM, et al. Efficacy and safety of adalimumab among patients with moderate to severe psoriasis with co-morbidities: subanalysis of results from a randomized, double-blind, placebo-controlled, phase III trial. Am J Clin Dermatol 2011;12:51-62.
27. Rijken M, van Kerkhof M, Dekker J, Schellevis FG. Comorbidity of chronic diseases. Qual Life Res 2005;14:45-55.
28. Verbrugge LM, Lepkowski JM, Imanaka Y. Comorbidity and its impact on disability. Milbank Q 1989;67:450-84.
29. Merikangas KR, Ames M, Cui L, Stang PE, Ustun TB, von Korff M, et al. The impact of comorbidity of mental and physical conditions on role disability in the US adult household population. Arch Gen Psychiatry 2007;64:1180-8.
30. Girolomoni G, Gottlieb A. Focus on psoriatic arthritis and comorbidities. Exp Rev Dermatol 2008;3 Suppl:S35-6.
31. Schmieder A, Schaarschmidt ML, Umar N, Terris DD, Goebeler M, Goerdt S, et al. Comorbidities significantly impact patients' preferences for psoriasis treatments. J Am Acad Dermatol 2012;67:363-72.
32. Taylor W, Gladman D, Helliwell P, Marchesoni A, Mease P, Mielants H. Classification criteria for psoriatic arthritis: development of new criteria from a large international study. Arthritis Rheum 2006;54:2665-73.
33. Chandran V, Schentag CT, Gladman DD. Sensitivity of the Classification of Psoriatic Arthritis (CASPAR) Criteria in early psoriatic arthritis. Arthritis Care Res 2007;57:1560-3.
34. Ware JE, Sherbourne CD. The MOS 36-item Short-form Health Survey (SF-36): conceptual framework and item selection. Med Care 1992;30:473-83.
35. Rohekar S, Tom BD, Hassa A, Schentag CT, Farewell VT, Gladman DD. Prevalence of malignancy in psoriatic arthritis. Arthritis Rheum 2008;58:82-7.
36. Marks R, Barton SP, Shuttleworth D, Finlay AY. Assessment of disease progression in psoriasis. Arch Dermatol 1989;125:235-40.
37. Ware JE, Kosinski M, Keller SD. SF-36 physical and mental health summary scales: a user manual. Boston: New England Medical Center, The Health Institute; 1994.
38. Husted JA, Gladman DD, Farewell VT, Long JA, Cook RJ. Validating the SF-36 Health Survey Questionnaire in patients with psoriatic arthritis. J Rheumatol 1997;24:511-7.
39. Samsa G, Edelman D, Rothman ML, Williams GR, Lipscomb J, Matchar D. Determining clinically important differences in health status measures. A general approach with illustration to the Health Utilities Index Mark II. Pharmacoeconomics 1999;15:141-55.
40. Rupp I, Boshuizen HC, Jacobi CE, Dinant HJ, van den Bos G. Comorbidity in patients with rheumatoid arthritis: effect on health-related quality of life. J Rheumatol 2004;31:58-65.
41. Davis JA, Robinson RL, Le TK, Xie J. Incidence and impact of pain conditions and comorbid illnesses. J Pain Res 2011;4:331-45.
42. Zisman D, Eder L, Elias M, Laor A, Bitterman H, Rozenbaum M, et al. Clinical and demographic characteristics of patients with psoriatic arthritis in northern Israel. Rheumatol Int 2012;32:595-600.