Published in final edited form as:
Am J Med. 2013 December ; 126(12): 1089–1098. doi:10.1016/j.amjmed.2013.09.002.

Racial and Ethnic Disparities in Disease Activity in Rheumatoid Arthritis Patients

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Abstract

Background—Observational studies of patients with rheumatoid arthritis have suggested that racial and ethnic disparities exist for minority populations. We compared disease activity and clinical outcomes across racial and ethnic groups using data from a large, contemporary United States registry.

Methods—We analyzed data from two time periods (2005-2007 and 2010-2012). The Clinical Disease Activity Index was examined as both a continuous measure and as dichotomous measures of disease activity states. Outcomes were compared in unadjusted and a series of cross-sectional and longitudinal multivariable regression models.

Results—For 2005-2007, significant differences of mean disease activity level ($p<0.001$) were observed across racial and ethnic groups. Over the five-year period, modest improvements in disease activity were observed across all groups, including whites [3.7 (95% CI 3.2 - 4.1) compared with African Americans [4.3 (95% CI 2.7 – 5.8)] and Hispanics [2.7 (95% CI 1.2 – 4.3)]. For 2010-2012, significant differences of mean disease activity level persisted ($p<0.046$)

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Conflicts of interest: The CORRONA registry has received financial support unrelated to this study from Abbott, Amgen, Astra-Zeneca, Eli Lilly, Genentech, Pfizer, UCB and Vertex. Dr. Greenberg receives consulting fees from Astra Zeneca, CORRONA, Novartis and Pfizer, and is a shareholder in CORRONA. Dr. Reed, Dr. Shan and Dr. Harrold have research contracts with CORRONA through the University of Massachusetts. Dr. Kremer is an employee and stockholder of CORRONA, receives consulting fees from Amgen, Abbott, Genetech, and Pfizer, and has research grants from Bristol-Myers Squibb, Genentech, Pfizer, UCB, HGS. Dr. Yazici has received consulting fees from Abbott, BMS, Celgene, Genentech, Merck, Pfizer, Horizon and UCB, as well as research support from BMS, Celgene, Janssen (Centocor) and Genentech.

Authorship: All authors had access to the data and played a role in writing this manuscript.

across racial and ethnic groups, ranging from 11.6 (95% CI 10.4-12.8) in Hispanics to 10.7 (95% CI 9.6-11.7) in whites. Remission rates remained significantly different across racial/ethnic groups across all models for 2010-2012, ranging from 22.7 (95% CI 19.5-25.8) in African Americans to 27.4 (95% CI 24.9-29.8) in whites.

Conclusions—Despite improvements in disease activity across racial and ethnic groups over a 5-year period, disparities persist in disease activity and clinical outcomes for minority groups versus white patients.

Keywords

Rheumatoid Arthritis; Disparities; Disease activity

INTRODUCTION

Rheumatoid arthritis is a chronic arthritic disease associated with progressive joint damage, diminished quality of life, disability and premature mortality [(1-3)]. In the past two decades, the treatment paradigm has rapidly evolved to earlier, more aggressive treatment with the use of highly effective and well-tolerated disease-modifying antirheumatic drugs (DMARDs) [(4-6)]. Specifically, the use of biologic DMARDs and combination DMARD therapy have been shown to improve both disease activity levels and patient functional status. As a result, treatment recommendations have been developed that recommend earlier, more aggressive treatment strategies, incorporating disease activity measurement into routine care and targeting clinical remission for all rheumatoid arthritis patients, or at least low disease activity state as an alternative goal in patients with longstanding rheumatoid arthritis[(4-7)].

Despite these advances, conflicting evidence has emerged regarding whether or not racial and ethnic disparities in clinical outcomes exist for patients with rheumatoid arthritis [(8-11)]. Some evidence from these studies suggests that African American and Hispanic patients have higher disease activity level and worse functional status than white patients. Of note, these studies were primarily conducted at academic medical centers, some of which were single center studies. Therefore, it remains largely unknown the extent to which racial and ethnic disparities exist in minority patients treated in community-based rheumatology practices, a major public health concern that has been identified by the National Institute of Health (NIH) RoadMap Initiative[(12)].

To address these questions, we analyzed registry data from two time periods (2005-2007 and 2010-2012) of patients participating in the Consortium of Rheumatology Researchers of North America (CORRONA) rheumatoid arthritis registry, a multi-center observational cohort study of patients treated by U.S.-based rheumatologists.. Specifically, we investigated whether clinical outcomes for white rheumatoid arthritis patients differed from outcomes that were observed in African American, Hispanic and Asian patients participating in the registry.

METHODS

Data source

The CORRONA registry is a longitudinal observational cohort study of patients with rheumatoid arthritis or psoriatic arthritis who are enrolled by participating rheumatologists in both community-based and academic clinical sites; the details have been previously published [13, 14]. Over the study period, a total of 112 community-based practices and 32 academic practices contributed patient data to the registry. Approvals for data collection and analyses were obtained for academic and community-based practice sites from local and central institutional review boards, respectively.

Study cohorts

We constituted two analytic cohorts to investigate disparities over two time periods (2005-2007 and 2010-2012). The first cohort included patient data from the earliest registry visit (2005-2007 index visit) for each patient between January 1, 2005 and May 1, 2007 (2005-2007 cohort). The second cohort included patient data from the last registry visit (2010-2012 index visit) between January 1, 2010 and May 1, 2012. No disease-related or drug-related inclusion or exclusion criteria were applied to create these analytic cohorts from the registry population. Greater than 90% of patient cohorts from both time periods were recruited from participating private practice rheumatology sites, with the remainder from academic-affilated sites.

Measures and Data Collection

Data were collected during both time periods from both physician assessments and patient questionnaires that were completed during clinical visits as part of routine care. Race and ethnicity were reported on the patient questionnaire. Rheumatoid arthritis measures of disease severity and activity were collected including tender and swollen joint count assessments (28 joints), physician and patient global assessments of disease activity, patient functional status using the modified Health Assessment Questionnaire (mHAQ) and clinical lab results performed as part of routine clinical care. Nonbiologic and biologic disease modifying anti-rheumatic drug (DMARD) use was reported by the treating rheumatologist.

Study outcome measures

For this study, we used the Clinical Disease Activity Index (CDAI), a validated composite measure of disease activity for rheumatoid arthritis patients [15]. The CDAI is a continuous outcome measure with possible scores ranging from 0 to 76. The CDAI was selected for the study as the measure of disease activity level and disease activity states due to the completeness of the CDAI components (97.7%) in the dataset. We analyzed the CDAI as the study outcome using 3 approaches: 1) as a continuous variable outcome; 2) achievement of low disease activity state as a dichotomous outcome; and 3) achievement of clinical remission as a dichotomous outcome. We used validated cut points for achievement of low disease activity state (CDAI score ≤10) and remission (CDAI score ≤2.8) as previously published[16]. As an exploratory secondary outcome, we also examined self-reported patient

functional status as reported using the modified Health Assessment Questionnaire (mHAQ) assessment [17].

Primary predictor variable

The primary explanatory variable was patient self-reported race and ethnicity, which was collected at the time of enrollment into the registry. Race categories on the questionnaire were based on the standard categories used by the National Institute of Health including white, African American, Asian, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander [18]. Ethnicity was self-reported by the patient as either Hispanic/Latino or non-Hispanic/non-Latino. Based on the distribution across racial and ethnic categories, we created the following four groups for the purpose of our study: white (non-Hispanic), African American (non-Hispanic), Hispanic and Asian.

Covariates

We created four categories of covariates for adjustment in the multivariable models, consisting of: a) Model 1-- practice setting (academic versus community-based practice); b) Model 2-- patient demographic/socioeconomic factors including age, gender, education, marital status, smoking history, current smoking status, insurance type; c) Model 3 -- markers of rheumatoid arthritis severity including rheumatoid arthritis disease duration, rheumatoid factor seropositive status, presence of radiographic erosions, disability status, number of prior DMARDs discontinued; and d) Model 4 -- current rheumatoid arthritis treatment including current use of methotrexate, weekly methotrexate dosage, current use of other non-methotrexate nonbiologic DMARDs, current use of a biologic drug, current prednisone use and daily prednisone dosage. Finally, we incorporated all significant variables from Models 1-4 into a final model (Model 5).

Statistical Analysis

We performed two cross-sectional analyses using data from the index visit for each study period. For each study period, we compared demographic and clinical characteristics across racial and ethnic cohorts. Unadjusted means of CDAI and mHAQ were estimated by racial and ethnic groups. In order to evaluate adjusted differences in CDAI and mHAQ by racial and ethnic groups, we estimated each outcome using mixed model linear regression with practice site as a random effect (patients nested within practice site). Each model included race and ethnicity. We constructed a series of five multivariable regression models including each category of covariates individually (Models 1, 2 , 3 and 4) and then in a final model we combined those factors that were significant ($p<0.05$) from Models 1-4 (Model 5). The categories of covariates included practice setting (Model 1), patient demographic/socioeconomic factors (Model 2); markers of rheumatoid arthritis severity (Model 3), current rheumatoid arthritis treatment (Model 4) and all significant factors (Model 5). An overall likelihood ratio test was used to test the significant association of race/ethnicity with each outcome in the models and if significant, pairwise tests (Wald chi-square) were used to compare each race to the reference group of white. Collinearity was assessed by examination of standard errors (variance inflation) and all models used the same sample of patients.

We also performed a longitudinal analysis, using all patients with at least one study visit in both the 2005-2007 and 2010-2012 time periods. We analyzed each of the study outcomes (CDAI as a continuous variable, low disease activity state, remission and mHAQ score) over the 5-year period as unadjusted models and fully adjusted models (Model 5), comparing the change over time in whites versus African Americans, Hispanics and Asians. We assessed statistical significance using a p-value threshold of <0.05 for the interaction term of race/ethnic group by time to determine if there were differences over time in white patients versus other racial/ethnic groups. All statistical analyses were conducted using Stata, version 12 (Stata Corporation, College Station, TX).

RESULTS

Demographic and clinical characteristics

Baseline demographic and clinical characteristics of the two study cohorts are summarized in **Table 1.** For both the 2005-2007 and 2010-2012 cohorts, the majority of the patients were female, with a higher proportion of female patients for African Americans, Hispanics and Asians versus white patients. In both cohorts, the mean age was approximately 60 years old, although white patients were slightly older than the other racial/ethnic groups in both time periods. The majority of rheumatoid arthritis patients were rheumatoid factor positive, although this varied across racial/ethnic groups, with white patients noted to have the lowest percentage of rheumatoid factor positive results in both cohorts. Other clinical characteristics of rheumatoid arthritis severity and current treatments are also summarized in **Table 1**.

Rheumatoid Arthritis Disease Activity Level

As shown in **Table 2**, significant differences of mean CDAI scores were observed across the racial and ethnic groups ($p<0.001$) in unadjusted comparisons for both the 2005-2007 and 2010-2012 cohorts. These differences remained significant across all 5 multivariable models, including adjustment for practice setting in Model 1, patient demographic/socioeconomic factors in Model 2, markers of rheumatoid arthritis severity in Model 3, current rheumatoid arthritis treatments in Model 4 and all significant factors simultaneously in Model 5. Pairwise comparisons for the contemporary (2010-2012) cohort demonstrated significant differences across all models for Hispanics versus whites. In the fully adjusted model, the mean CDAI score for Hispanics (11.63, 95% CI 10.42-12.83) remained significantly higher than whites (10.65, 95% CI 9.63-11.68). Other significant predictors of CDAI score in Model 5 for the contemporary (2010-2012) cohort included patient age ($\beta=0.97$, $p<0.001$), female gender ($\beta=2.60$, $p<0.001$) , smoking history ($\beta=1.59$, $p=0.006$), college education ($\beta=0.35$, $p<0.001$), presence of health insurance ($\beta=16.2$, $p<0.001$), duration of rheumatoid arthritis ($\beta=0.96$, $p<0.001$) , number of prior DMARDs ($\beta=3.56$, $p<0.001$), radiographic erosions ($\beta=1.62$, $p=0.008$) and self-reported disability ($\beta=110.55$, $p<0.001$), as well as current usage of methotrexate ($\beta=2.30$, $p<0.001$) , non-methotrexate non-biologic DMARD ($\beta=2.51$, $p<0.001$), and prednisone ($\beta=34.92$, $p<0.001$).

Low Disease Activity State and Clinical Remission Outcomes

As shown in **Table 3a**, greater than 50% of patients in both time periods achieved the low disease activity state, improving from 53.3% (95% CI 52.4-54.3) in 2005-2007 to 63.7% (95% CI 63.0-64.4) in 2010-2012. During both time periods, the unadjusted rates of low disease activity state varied across race and ethnic groups (p<0.001). For 2005-2007, all adjusted models demonstrated significant differences across race/ethnic groups. For 2010-2012, similar trends were observed, with rates varying across groups in Models 1 through 4, but lost significance in the fully adjusted model (p=0.068).

For clinical remission **(Table 3b)**, there was also substantial improvement noted when comparing the 2005-2007 and 2010-2012 time periods, improving overall from 21.6% (95% CI 20.8-22.4) to 28.5% (95% CI 27.9-29.1). Across both time periods and across all 5 models, the rate of clinical remission varied across the race/ethnic groups (all p-values <0.05). In pairwise comparisons, African Americans consistently achieved lower rates of remission than white patients. In the fully adjusted model for 2005-2007, the rate of remission was significantly lower in African Americans (15.7%, 95% CI 11.8-19.6) versus whites (20.9%, 95% CI 18.0-23.8). For 2010-2012, despite improvement in rates for both racial groups, rate of remission remained significantly lower in African Americans (22.7%, 95% CI 19.5-19.6) versus whites (27.4%, 95% CI 24.9-29.8).

Patient Functional Status

As a secondary outcome, we also compared patient functional status using the modified Health Assessment Questionnaire across racial and ethnic groups (**Table 4**). Similar to the other study outcomes, the modified Health Assessment Questionnaire score varied across racial and ethnic groups in both study periods across all multivariable models. Moreover, pairwise comparisons versus whites consistently demonstrated worse functional status (higher mHAQ scores) for both African Americans and Hispanics versus whites across all models, including the fully adjusted model (Model 5).

Longitudinal Analysis

A total of 6,008 patients had study visits in both the 2005-2007 and 2010-2012 study periods. As shown in **Table 5a**, similar improvements in CDAI over the 5-year period were observed in whites compared with African Americans, Hispanics and Asians in unadjusted comparisons (all p-values >0.10). In the fully adjusted model, white patients improved their CDAI score over the 5-year period by 3.7 (95% CI 3.2 – 4.1), with similar improvements observed for African Americans [4.3 (95% CI 2.7 – 5.8)], Hispanics [2.7 (95% CI 1.2 – 4.3)] and Asians [2.0 (95% CI -0.7 – 4.6)], with no significant interaction of race/ethnicity with time as a predictor of change in CDAI (all p-values >0.1). Similarly, there were no differences across race/ethnic group in terms of improvement of functional status over the study period **(Table 5b).** Models of the likelihood of change in low disease activity state and remission are shown in **Table 6.** In the 2010-2012 period compared to the 2005-2007 period, whites were more than twice as likely to achieve low disease activity state (Odds Ratio [OR] =2.7, 95% CI 2.4-4.1), which was similar to the improved likelihood for other minority groups to improve over the time period (all p-values >0.1). For example, the likelihood for African Americans was more than 3-fold (OR 3.3, 95% CI 1.9-4.7) and for

Hispanics was more than two-fold (OR 2.4 (95% CI 1.4-3.5). Similar improvements were observed across groups for achieving remission **(Table 6)**, with no differences across racial/ethnic groups (all p-values >0.1).

DISCUSSION

In this study, we observed significant racial and ethnic variation in disease activity in a large U.S.-based cohort of rheumatoid arthritis patients. We also observed differences in functional status across racial and ethnic groups. In comparisons of minority groups versus white patients in both time periods, we observed that Hispanic patients had higher disease activity levels, whereas African American patients achieved lower rates of clinical remission. For both time periods, African American and Hispanic patients reported worse functional status versus white patients. In longitudinal analyses, we noted that disease activity improved across all race/ethnic groups over the 5-year period, without eliminating the observed disparities. These findings reinforce the prior literature demonstrating racial and ethnic disparities in clinical outcomes for rheumatoid arthritis patients, and suggest that these disparities persist into the second decade of this century.

Although prior studies have examined whether levels of rheumatoid arthritis disease activity varied across racial and ethnic groups, the prior studies involved substantially smaller numbers of patients-- both as an overall cohort and with respect to the number of patients in the minority groups [8-11]. Moreover, these studies were predominantly conducted at individual academic centers, recruiting patients from one or two academic-affiliated clinics, with the exception of the study using the Arthritis, Rheumatism, and Aging Medical Information System (ARAMIS) database from nine rheumatology practices [9]. The study cohort for this analysis was derived from the CORRONA registry, including patients from 144 sites, predominantly community-based rheumatology practices. Thus, our study extends upon prior findings of racial and ethnic disparities observed in other studies beyond academic centers to community, U.S.-based rheumatology practices. Moreover, since one of our study cohorts selected the most recent registry visit in the 2010-2012 time period, it also sheds light on whether progress has been made over time on previously reported disparities in minorities. Our study suggests that racial and ethnic disparities have not been eliminated for RA patients, despite marked improvements across all race/ethnic groups over a five-year observation period.

Of particular note, despite numerous baseline differences in demographic, socioeconomic and rheumatoid arthritis -related factors among the race and ethnic groups, our study demonstrated the persistence of observed disparities after adjustment for these factors in the majority of the multivariate models. For example, despite the fact that African American rheumatoid arthritis patients had a higher prevalence of radiographic erosions with reduced biologic drug utilization versus white patients, lower rates of clinical remission persisted in adjusted comparisons for African American versus white rheumatoid arthritis patients. Similarly, Hispanics were observed to have higher rates of biologic drug utilization than white patients, yet had persistently higher rheumatoid arthritis disease activity than whites in adjusted models. Therefore, it remains unclear what underlying mechanisms or explanatory factors may be driving the observed disparities. Certain factors such as medication

adherence, for example, were not measured as part of the data collection in the registry, and could contribute to the observed disparities [19]. Similarly, differences in health beliefs across racial and ethnic groups could contribute as well, particularly for patient reported outcomes. In fact, major differences in beliefs and attitudes regarding rheumatoid arthritis treatment preferences between African American and white patients have been reported [20, 21].

In addition to the potential unmeasured role of psychological factors across racial and ethnic groups, it is important to note that the underlying genetic architecture for the development of rheumatoid arthritis has been noted to vary across racial and ethnic groups [22-25]. Moreover, the contribution of genetic factors may also interact with the contribution of autoantibodies and environmental factors to disease susceptibility[26]. In fact, our data suggests that autoantibody seropositivity, specifically rheumatoid factor, varies across racial and ethnic groups. However, our data on autoantibody status is primarily limited to serum rheumatoid factor based on data availability from clinical laboratory ordering patterns in routine care by participating rheumatologists. Thus, exploring the interaction of genetic, serologic and environmental factors is beyond the scope of our study and will require further investigation.

There are a number of strengths and potential limitations in our study. Our analysis represents the largest U.S.-based observational study of racial and ethnic disparities in rheumatoid arthritis clinical outcomes to our knowledge. Moreover, the data collection covered 144 sites and 455 rheumatologists, with the majority of the data collected from community-based rheumatology practices. This approach is consistent with the recommendations from the NIH RoadMap Initiative to reengineer the clinical research enterprise, including community-based investigators that can expedite study recruitment. Nevertheless, the generalizability of our study results remains a potential limitation of the study. [12]. It is also important to note the limitation that many of the differences observed between race and ethnic groups were statistically significant, but these differences may not be clinically meaningful for individual patients. In fact, the differences in disease activity level and functional status across racial and ethnic groups are smaller than the improvements reported in clinical trials of effective therapies. Residual bias is another study limitation. We were able to examine both physician-derived and patient-derived outcome measures, and account for a broad set of potential confounding variables. Nevertheless, it is possible that potential explanatory factors that were not part of the study data collection could influence the study results, such as genetic differences, medication adherence, patient literacy or household income.

Despite the continued growth of newly approved DMARD options and the publication of recommendations for standardized disease activity monitoring and treatment strategies, our study indicates that racial and ethnic disparities continue to exist across a network of U.S.-based rheumatology practices. Interventions to address these disparities for minority rheumatoid arthritis patients are needed to improve clinical outcomes.

Acknowledgments

Funding: Dr. Greenberg was supported with grants from the NIH/NIAMS (K23 AR054412) and the NIH/NCRR (5UL1RR029893). Dr. Harrold has also received support from the NIH (AR053856).

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Clinical Significance

- Differences in disease activity levels across racial and ethnic groups were observed in a large United States rheumatoid arthritis cohort.
- Improvement in disease activity level over a 5-year period were observed across all race and ethnic groups
- In the 2010-2012 cohort, racial and ethnic disparities in disease activity and remission rates persisted for rheumatoid arthritis patients.

Table 1

Demographic and clinical characteristics of study population by racial and ethnic cohort

	2005-2007				2010-2012			
	White	African American	Hispanic	Asian	White	African American	Hispanic	Asian
	N=10,088	N=750	N=757	N=203	N=17,687	N=1,492	N=1,095	N=355
Patient Demographics								
Patient age	59.84	59.15	55.02	54.58	61.27	59.80	57.60	56.52
Female (%)	74.66	80.93	80.98	81.77	75.72	83.98	80.90	85.92
Ever smoked (%)	44.00	33.20	35.40	24.14	49.64	42.56	37.08	24.51
Current smoker (%)	15.92	14.80	14.13	10.84	15.57	16.76	12.88	7.89
College education (%)	51.55	54.40	41.68	74.87	58.21	56.95	48.11	78.49
Insurance (%)								
Medicare	40.39	44.80	35.27	24.14	37.10	40.18	29.02	25.85
Medicaid	4.98	16.13	19.68	9.85	4.04	14.11	14.33	7.95
Private	75.95	58.40	58.92	75.86	74.11	60.84	66.02	71.31
No insurance	1.35	3.47	5.15	3.45	1.50	2.97	4.78	4.55
Markers of Rheumatoid Arthritis Severity								
Rheumatoid factor positive (%)	73.61	79.56	76.17	78.35	69.63	79.81	78.22	76.39
Duration of disease	10.86	9.77	10.67	9.00	12.27	10.56	11.79	10.89
Presence of x-ray erosions (%)	50.26	58.81	59.30	49.26	48.15	55.45	51.46	52.49
Number of prior failed DMARDs	1.11	0.81	1.10	1.00	1.51	1.23	1.52	1.41
Disabled (%)	11.49	22.49	24.37	12.81	10.98	19.99	20.66	9.12
Current Rheumatoid Arthritis Treatment								
MTX use (%)	64.90	69.33	65.92	67.98	60.48	62.60	61.10	63.10
MTX dosage (mg/week)	14.34	13.23	14.00	13.77	16.03	16.30	15.96	15.89
Non-MTX nonbiologic DMARD(%)	29.39	27.87	27.34	29.56	28.41	27.88	30.50	30.42
Biologic drug (%)	40.87	42.27	44.25	44.83	48.66	44.24	52.51	45.92
Prednisone use (%)	30.09	30.53	28.53	27.09	22.57	23.99	24.84	18.31
Prednisone current dose (mg/day)	7.61	3.40	7.50		6.83	7.09	6.72	5.56

Notes:

Values are the mean unless otherwise indicated

Abbreviations: DMARD= disease modifying antirheumatic drug; MTX=methotrexate

Table 2

Disease activity level by race and ethnicity

	2005-2007				2010-2012			
	Mean	**95% CI**	**Pairwise *P* value**	**Overall *P* value**	**Mean**	**95% CI**	**Pairwise *P* value**	**Overall *P* value**
Unadjusted Values								
All patients	12.94	(12.69-13.18)		<0.001	10.35	(10.19-10.51)		<0.001
White	12.54	(12.29-12.8)			10.17	(9.99-10.34)		
Black	15.26	(14.18-16.34)	<0.001		10.87	(10.31-11.43)	0.024	
Hispanic	16.86	(15.74-17.97)	<0.001		12.86	(12.02-13.71)	<0.001	
Asian	10.15	(8.69-11.62)	0.008		9.92	(8.62-11.21)	0.692	
Adjusted Values								
Model 1				<0.001				<0.001
White	12.3	(11.24-13.37)			10.54	(9.48-11.6)		
Black	14.38	(12.97-15.8)	<0.001		11.31	(10.11-12.5)	0.014	
Hispanic	13.6	(12.21-14.98)	0.008		12.32	(11.07-13.58)	<0.001	
Asian	8.9	(6.93-10.87)	<0.001		10.57	(9-12.13)	0.962	
Model 2				<0.001				0.004
White	12.45	(11.39-13.52)			10.63	(9.64-11.62)		
Black	13.95	(12.53-15.37)	0.004		10.82	(9.69-11.95)	0.536	
Hispanic	13.15	(11.77-14.53)	0.153		11.95	(10.76-13.14)	<0.001	
Asian	9.21	(7.25-11.17)	<0.001		10.67	(9.16-12.18)	0.955	
Model 3				<0.001				0.003
White	12.22	(11.22-13.23)			10.64	(9.66-11.62)		
Black	14.00	(12.65-15.36)	0.001		11.18	(10.07-12.29)	0.072	
Hispanic	13.08	(11.76-14.4)	0.074		11.88	(10.7-13.05)	<0.001	
Asian	8.98	(7.07-10.89)	<0.001		10.82	(9.35-12.3)	0.751	
Model 4				<0.001				<0.001
White	12.34	(11.28-13.4)			10.58	(9.55-11.61)		
Black	14.27	(12.86-15.67)	<0.001		11.30	(10.15-12.46)	0.018	
Hispanic	13.64	(12.28-15.01)	0.007		12.23	(11.02-13.45)	<0.001	
Asian	8.99	(7.05-10.93)	<0.001		10.77	(9.25-12.29)	0.749	
Model 5				<0.001				0.046
White	12.38	(11.36-13.4)			10.65	(9.63-11.68)		
Black	13.75	(12.39-15.1)	0.007		10.88	(9.73-12.02)	0.455	
Hispanic	13.01	(11.68-14.34)	0.179		11.63	(10.42-12.83)	0.005	
Asian	9.23	(7.34-11.12)	<0.001		10.90	(9.41-12.39)	0.666	

Note: Disease activity defined by the Clinical Disease Activity Index (CDAI)

Table 3a

Achievement of low disease activity state by race and ethnicity

	2005-2007				2010-2012			
	%	95% CI	Pairwise *P* value	Overall *P* value	%	95% CI	Pairwise *P* value	Overall *P* value
Unadjusted Rates								
All patients	53.3	(52.4-54.3)		<0.001	63.7	(63-64.4)		<0.001
White	54.7	(53.7-55.8)			64.5	(63.8-65.3)		
Black	43.3	(39.2-47.3)	<0.001		58.4	(55.7-61)	<0.001	
Hispanic	41.2	(37.5-45)	<0.001		56.1	(53-59.3)	<0.001	
Asian	62.8	(55.8-69.9)	0.029		65.5	(60.2-70.8)	0.729	
Adjusted Rates								
Model 1				<0.001				<0.001
White	53.4	(48.8-58)			63.2	(60-66.3)		
Black	44.6	(38.6-50.5)	<0.001		58.0	(53.9-62.1)	<0.001	
Hispanic	50.6	(44.7-56.4)	0.158		57.2	(52.8-61.7)	<0.001	
Asian	64.1	(56.2-72)	0.003		62.8	(56.7-68.8)	0.882	
Model 2				<0.001				0.026
White	53.4	(48.7-58.1)			28.4	(25.8-30.9)		
Black	46.6	(40.5-52.8)	0.002		23.7	(20.4-26.9)	0.039	
Hispanic	52.4	(46.5-58.3)	0.636		24.4	(20.8-28)	0.015	
Asian	63.4	(55.5-71.4)	0.005		27.0	(21.7-32.3)	0.998	
Model 3				<0.001				0.001
White	54.2	(49.6-58.8)			62.2	(59.1-65.3)		
Black	46.1	(40.1-52.1)	<0.001		57.7	(53.7-61.7)	0.001	
Hispanic	52.6	(46.8-58.4)	0.410		58.2	(53.9-62.5)	0.013	
Asian	64.2	(56.5-72)	0.004		61.2	(55.3-67.1)	0.690	
Model 4				<0.001				<0.001
White	53.2	(48.5-58)			62.6	(59.3-65.8)		
Black	45.1	(39.1-51.1)	<0.001		57.6	(53.5-61.7)	<0.001	
Hispanic	50.4	(44.6-56.3)	0.154		57.3	(52.9-61.7)	0.001	
Asian	63.8	(56-71.6)	0.002		61.6	(55.6-67.6)	0.710	
Model 5				<0.001				0.068
White	53.6	(49-58.2)			61.7	(58.5-64.8)		
Black	46.9	(41-52.9)	0.001		58.6	(54.6-62.6)	0.022	
Hispanic	52.6	(46.8-58.3)	0.606		59.2	(54.8-63.5)	0.110	
Asian	63.0	(55.3-70.8)	0.006		60.9	(55-66.8)	0.762	

Note: Disease activity defined by the Clinical Disease Activity Index (CDAI);

Values are the mean with 95% confidence intervals.

Adjusted models included a series of five mixed model linear regression models including: practice setting (Model 1), patient demographic/ socioeconomic factors (Model 2); markers of rheumatoid arthritis severity (Model 3), current rheumatoid arthritis treatment (Model 4) and all significant factors (p<0.05) from Models 1 through 4 (Model 5)

Table 3b

Achievement of remission† by race and ethnicity

	2005-2007				2010-2012			
	%	95% CI	Pairwise *P* value	Overall *P* value	%	95% CI	Pairwise *P* value	Overall *P* value
Unadjusted Rates								
All patients	21.6	(20.8-22.4)		<0.001	28.5	(27.9-29.1)		<0.001
White	22.4	(21.5-23.3)			29.2	(28.5-29.9)		
Black	15.1	(12.1-18)	<0.001		23.4	(21.2-25.7)	<0.001	
Hispanic	16.2	(13.4-19)	<0.001		23.6	(20.9-26.3)	<0.001	
Asian	23.5	(17.3-29.7)	0.952		31.3	(26.2-36.5)	0.253	
Adjusted Rates								
Model 1				0.002				<0.001
White	21.4	(18.3-24.6)			29.0	(26.2-31.8)		
Black	14.7	(10.8-18.6)	<0.001		22.8	(19.4-26.2)	<0.001	
Hispanic	20.3	(16-24.6)	0.509		24.2	(20.4-27.9)	0.002	
Asian	23.8	(17-30.6)	0.427		28.4	(22.8-34)	0.813	
Model 2				0.021				0.001
White	20.9	(17.8-24.1)			28.4	(25.8-30.9)		
Black	15.4	(11.4-19.5)	0.002		23.7	(20.4-26.9)	<0.001	
Hispanic	20.9	(16.5-25.3)	0.968		24.4	(20.8-28)	0.011	
Asian	22.3	(15.8-28.9)	0.633		27.0	(21.7-32.3)	0.578	
Model 3				0.004				<0.001
White	21.7	(18.7-24.8)			27.9	(25.3-30.4)		
Black	15.3	(11.4-19.2)	<0.001		22.2	(19.1-25.3)	<0.001	
Hispanic	21.4	(17.1-25.8)	0.865		24.1	(20.6-27.6)	0.022	
Asian	23.4	(16.9-30)	0.570		27.7	(22.6-32.8)	0.629	
Model 4				0.006				<0.001
White	21.2	(18.1-24.2)			27.5	(24.9-30.2)		
Black	15.1	(11.2-19)	0.001		21.6	(18.4-24.8)	<0.001	
Hispanic	20.4	(16.2-24.6)	0.623		23.2	(19.6-26.8)	0.004	
Asian	23.4	(16.8-30)	0.450		26.3	(21.1-31.6)	0.620	
Model 5				0.028				0.001
White	20.9	(18-23.8)			27.4	(24.9-29.8)		
Black	15.7	(11.8-19.6)	0.003		22.7	(19.5-25.8)	<0.001	
Hispanic	21.2	(17-25.5)	0.861		24.6	(21-28.2)	0.064	
Asian	21.9	(15.7-28.2)	0.720		25.3	(20.3-30.2)	0.363	

Note: Remission defined as the Clinical Disease Activity Index Score ≤2.8

Values are the mean with 95% confidence intervals.

Adjusted models included a series of five mixed model linear regression models including: practice setting (Model 1), patient demographic/ socioeconomic factors (Model 2); markers of rheumatoid arthritis severity (Model 3), current rheumatoid arthritis severity treatment (Model 4) and all significant factors (p<0.05) from Models 1 through 4 (Model 5)

Table 4

Patient functional status by race and ethnicity

	2005-2007				2010-2012			
	Mean	**95% CI**	**Pairwise *P* value**	***Overall P* value**	**Mean**	**95% CI**	**Pairwise *P* value**	***Overall P* value**
Unadjusted Values								
All patients	0.38	(0.37-0.39)		<0.001	0.35	(0.34-0.35)		<0.001
White	0.36	(0.35-0.37)			0.33	(0.33-0.34)		
Black	0.47	(0.43-0.51)	<0.001		0.44	(0.41-0.46)	<0.001	
Hispanic	0.52	(0.48-0.56)	<0.001		0.44	(0.41-0.47)	<0.001	
Asian	0.29	(0.23-0.35)	0.028		0.32	(0.27-0.37)	0.557	
Adjusted Values								
Model 1				<0.001				<0.001
White	0.35	(0.32-0.38)			0.33	(0.31-0.35)		
Black	0.46	(0.42-0.51)	<0.001		0.43	(0.4-0.46)	<0.001	
Hispanic	0.45	(0.4-0.49)	<0.001		0.43	(0.39-0.46)	<0.001	
Asian	0.26	(0.19-0.33)	0.008		0.33	(0.28-0.38)	0.977	
Model 2				<0.001				<0.001
White	0.36	(0.34-0.39)			0.33	(0.31-0.35)		
Black	0.43	(0.39-0.47)	0.001		0.38	(0.35-0.41)	<0.001	
Hispanic	0.42	(0.38-0.46)	0.004		0.41	(0.37-0.44)	<0.001	
Asian	0.29	(0.22-0.36)	0.026		0.34	(0.29-0.4)	0.612	
Model 3				<0.001				<0.001
White	0.36	(0.33-0.38)			0.34	(0.32-0.35)		
Black	0.44	(0.4-0.48)	<0.001		0.41	(0.38-0.44)	<0.001	
Hispanic	0.42	(0.38-0.46)	0.001		0.40	(0.37-0.43)	<0.001	
Asian	0.28	(0.21-0.34)	0.014		0.35	(0.3-0.4)	0.573	
Model 4				<0.001				<0.001
White	0.36	(0.33-0.39)			0.34	(0.31-0.36)		
Black	0.47	(0.42-0.51)	<0.001		0.43	(0.4-0.46)	<0.001	
Hispanic	0.45	(0.41-0.5)	<0.001		0.43	(0.39-0.46)	<0.001	
Asian	0.27	(0.2-0.34)	0.011		0.34	(0.29-0.4)	0.707	
Model 5				<0.001				<0.001
White	0.36	(0.34-0.38)			0.33	(0.31-0.35)		
Black	0.43	(0.39-0.46)	0.001		0.38	(0.36-0.41)	<0.001	
Hispanic	0.41	(0.37-0.45)	0.008		0.38	(0.35-0.42)	<0.001	
Asian	0.30	(0.23-0.36)	0.037		0.36	(0.32-0.41)	0.164	

Notes:

(1)Functional status reported by patient using the modified Health Assessment Questionnaire

(2)Values are the mean with 95% confidence intervals.

Table 5a

Longitudinal analysis of change in disease activity level over 5 year period

	CDAI Change	95% Confidence Interval	*P* value*
Unadjusted Model			
White	−2.81	(−3.19, −2.44)	Referent
Black	−3.46	(−4.97, −1.95)	0.416
Hispanic	−1.65	(−3.15, −0.15)	0.141
Asian	−1.53	(−4.18, 1.13)	0.346
Adjusted Model			
White	−3.65	(−4.09, −3.21)	Referent
Black	−4.27	(−5.8, −2.74)	0.434
Hispanic	−2.73	(−4.25, −1.21)	0.244
Asian	−1.97	(−4.62, 0.69)	0.217

* comparing change in clinical disease activity index (CDAI) for each race versus change for whites

Table 5

b Longitudinal analysis of change in patient function over 5 year period

	mHAQ Change	95% Confidence Interval	*P* value*
Unadjusted model			
White	0.04	(0.03, 0.05)	Referent
Black	0.01	(−0.03, 0.06)	0.331
Hispanic	0.01	(−0.04, 0.06)	0.259
Asian	0.08	(0, 0.17)	0.304
Adjusted final model			
White	−0.03	(−0.04, −0.01)	Referent
Black	−0.05	(−0.1, 0)	0.387
Hispanic	−0.07	(−0.12, −0.02)	0.129
Asian	0.04	(−0.05, 0.13)	0.122

* comparing change in patient function defined as the modified Health Assessment Questionnaire (mHAQ) score for each race versus whites

Table 6

Longitudinal analysis of likelihood of achieving low disease activity and remission over 5 year period

	Low Disease Activity			Remission		
	Odds Ratio	**95% CI**	***P* value***	**Odds Ratio**	**95% CI**	***P* value***
Unadjusted model						
White	2.04	(1.82, 2.27)	Referent	1.75	(1.55, 1.96)	Referent
Black	2.54	(1.48, 3.61)	0.317	1.78	(0.86, 2.69)	0.954
Hispanic	1.75	(1.02, 2.47)	0.478	1.81	(0.92, 2.71)	0.897
Asian	2.52	(0.55, 4.48)	0.601	1.3	(0.24, 2.36)	0.475
Adjusted Final Model						
White	2.71	(2.35, 3.07)	Referent	2.52	(2.17, 2.88)	Referent
Black	3.27	(1.86, 4.69)	0.398	2.46	(1.17, 3.75)	0.927
Hispanic	2.42	(1.39, 3.46)	0.610	2.79	(1.37, 4.21)	0.702
Asian	2.88	(0.61, 5.15)	0.880	1.58	(0.27, 2.9)	0.275

* comparing change of rates over time for each race versus change of rates in whites