Health Status Disparities in Ethnic Minority Patients with Rheumatoid Arthritis: A Cross-Sectional Study

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ABSTRACT. ***Objective.*** To examine disparities in disability, pain, and global health between Caucasian (n = 4294) and African American (n = 283) and Caucasian and Hispanic (n = 153) patients with rheumatoid arthritis (RA).

Methods. Patients were from 9 Arthritis, Rheumatism, and Aging Medical Information System databanks. Cross-sectional data were derived from the Health Assessment Questionnaire. Staged multivariate analysis of covariance was used to explore roles of possible contributing factors (age, sex, education, disease duration, number of comorbid conditions, and treatment) to ethnic minority disparities.

Results. The cohort was 91% Caucasian and 76% female. Caucasians were significantly older than African Americans and Hispanics (62 vs 56 and 55 yrs; both $p < 0.0001$ from Caucasians), better educated (13 vs 12 and 12 yrs; both $p < 0.0001$ from Caucasians), and had their RA longer (16 vs 13 and 15 yrs; $p < 0.01$ for African Americans). Unadjusted disability scores were statistically indistinguishable, but pain was worse in both ethnic groups ($p < 0.01$), and global health worse in Hispanics ($p < 0.05$). After adjustment for covariates, African Americans had the poorest outcomes in all 3 measures, although only pain in African Americans ($p < 0.05$) was statistically different from Caucasians.

Conclusion. Results of this exploratory study suggest that in a relatively similar cohort of patients with RA, minority health disparities exist. Both ethnic groups had poorer outcomes for all 3 measures than Caucasians after adjustment. Additional study and longitudinal research with larger numbers of patients are needed to improve our understanding of these differences and to assess potential causal roles. (First Release June 1 2007; J Rheumatol 2007;34:1475–9)

Key Indexing Terms:
HEALTH DISPARITIES
ETHNIC MINORITY
RHEUMATOID ARTHRITIS
HEALTH OUTCOMES

As the United States ethnically diverse population continues to grow, poor health outcomes in minorities represent a major public health problem. Marked differences in disease prevalence, manifestation, burden, management, and treatment between Caucasian and minority groups have been well documented[1]. The less favorable health status of minorities has been attributed, in part, to factors such as lower levels of education and income[1]. One of the central focuses of Healthy People 2010 is to eliminate these disparities[2].

Minority patients are hugely affected by inequities across a range of medical conditions. For instance, African American and Hispanic groups have higher rates of diabetes than Caucasians[3], and disparities in treatment and socioeconomic status have been documented in African American and Hispanic patients with systemic lupus erythematosus and scleroderma[4-7]. Minorities are also disproportionately affected by arthritis[1,2,8], which is among the most common disorders in the United States. Approximately one out of 3 Americans is affected by some kind of musculoskeletal condition at any given time, and the prevalence of arthritis is projected to increase considerably as baby boomers age[9]. In patients with arthritis, ethnic disparities in health outcomes are thus of increasing concern. Although several studies have examined ethnic health disparities in osteoarthritis or in arthritis generally[9-11], there are limited data on health disparities among minority patients with rheumatoid arthritis (RA).

Patient reported outcomes (PRO) of disability, pain, and global health are part of the 6 core outcomes assessed in many clinical trials in RA[12,13]. Both functional status and pain have been found to be central outcomes to patients with RA[14-16], while patient overall health status, as measured by patient global health, has been shown to reflect a patient's perception of their quality of life[17]. To our knowledge, these PRO have not been specifically studied in minority patients with RA, and overall, there is insufficient research in patients with RA in this area. Hence, as part of a longitudinal study examining minority disparities in RA, we conducted an initial exploratory cross-sectional investigation comparing these PRO in

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Supported by a grant from the National Institutes of Health to the Arthritis, Rheumatism, and Aging Medical Information System (P01-AR043584).

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Accepted for publication March 2, 2007.

Caucasian with African American RA patients and Caucasian with Hispanic RA patients. Our objectives were to determine whether health disparities exist and to examine possible contributing factors. We hypothesized that disparities in PRO of disability, pain, and global health would be greater in African Americans compared to Caucasians and in Hispanics compared to Caucasians. We also sought to ascertain whether longitudinal study is warranted.

MATERIALS AND METHODS

Patients. Data for this analysis were obtained from patients with RA in the Arthritis, Rheumatism, and Aging Medical Information System (ARAMIS). ARAMIS is a prospective, observational databank system that has been collecting semiannual questionnaire data in the US and Canada on patients with RA and osteoarthritis for 3 decades. ARAMIS patients are followed for life and assessed by standard protocol for multiple PRO. Patients have been enrolled consecutively by ARAMIS investigators from across the US and Canada and are representative of patients in the databank seen by the investigator. Study of cohorts of ARAMIS patients with RA has shown that in general they are similar to the general RA clinic population[18].

Data were collected using the Stanford Health Assessment Questionnaire (HAQ)[19]. The HAQ includes items on demographics, disability, pain, global health, lifestyle behaviors, medication use and adverse effects, comorbidities, and healthcare utilization. Questionnaires are reviewed by trained outcome assessors who follow up with patients for ambiguities, inconsistencies, or missing data using standard protocols[20].

ARAMIS patients were identified for our study if they had RA, were at least 18 years old, and had provided data on the variables relevant to this investigation. These cross-sectional analyses are based on each patient's last questionnaire rather than their baseline questionnaire, since for some patients baseline data had been collected before the HAQ existed and did not contain information on variables germane to these analyses. Ethnic groups were derived from patient self-identification as White (not of Hispanic origin), African American (not of Hispanic origin), Asian or Pacific Islander, American Indian/Alaskan/Alaskan Native/Canadian Indian, Hispanic/Chicano(a)/Latino(a), or Other. There were no provisions available to further classify Hispanics into more discrete categories. Due to small numbers, Asian or Pacific Islander (n = 74), American Indian/Alaskan/Alaskan Native/Canadian Indian patients (n = 28), and those identified as Other (n = 2) were not included. Three ethnic minority groups with sufficient numbers were identified: White (not of Hispanic origin), African American (not of Hispanic origin), and Hispanic/Chicano(a)/Latino(a). Patients (n = 198) for whom ethnic data were missing (they may have died or dropped out before these data had been obtained) were also removed.

Patient data were derived from 9 ARAMIS RA community-based and university-based databank centers in the US [Baltimore, Maryland (n = 191); Cincinnati, Ohio (n = 227); Pittsburgh, Pennsylvania (n = 558); Wichita, Kansas (n = 2444); and 4 RA databank centers from Stanford, California (n = 1322)]. The Canadian RA databank, which consists of predominately Caucasian patients and does not include patients from the minority groups studied here, was not included. Patients in ARAMIS databanks are representative of the patients seen at those sites. The study protocol and informed consent were approved by the Stanford University Administrative Panel on Human Subjects in Medical Research, and each patient gave written informed consent.

Measures. Demographic variables used to describe the group were: sex, age, education (yrs), age of onset of RA (yrs), disease duration (yrs), number of comorbid conditions, and number of disease modifying antirheumatic drugs (DMARD) at the last questionnaire. Medications used by this group were almost entirely traditional DMARD, as data were collected prior to large-scale use of biologics. The primary outcomes were disability, pain, and global health status.

Disability was measured using the HAQ Disability Index (HAQ-DI). The HAQ-DI is a validated self-report instrument that assesses the difficulty of completing tasks in 8 categories — dressing, arising, eating, walking, hygiene, reach, grip, and usual activities. Each category contains 2 or 3 subcategory items that describe behaviors related to the parent category. Patients respond to the stem "Are you able to ... e.g., climb up 5 steps," and score each item on a 4-point scale from 0 to 3, ranging from 0 = no difficulty to 3 = unable to do. The HAQ-DI is obtained by summing the maximum score among the subcategories in each category and then dividing by 8, yielding a score between 0 (no disability) and 3 (completely disabled). The HAQ-DI has demonstrated reliability and validity in hundreds of studies since its inception nearly 30 years ago[21].

Pain was assessed using the HAQ's double-anchored visual analog scale (VAS). Patients were asked to evaluate the amount of pain they have due to their illness by placing a mark on a line from 0 to 100 (100 = severe pain) to indicate the severity of their pain. The HAQ pain VAS has undergone extensive testing and validation and has been used widely in experimental, observational, and clinical settings[21].

Patient global health was assessed using the HAQ's double-anchored VAS. It asked patients to consider all the ways that their arthritis affects them by placing a vertical mark on a scale from 0 to 100, with higher scores indicating a worse outcome. The HAQ global health VAS is among common VAS instruments that are used to measure quality of life and has been validated as such[17].

Measurements of pain and global health were therefore scaled in the same units. Higher scores on all 3 scales indicate worse health status.

Statistical analyses. Student's t tests and chi-square were used to assess differences in patient demographic characteristics and study outcomes. Due to small sample sizes, analyses were restricted to examining differences between 2 groups: Caucasians and African Americans and Caucasians and Hispanics. Multivariable analysis of covariance was used to examine the contribution of potential factors associated with minority differences. Covariates were databank center, age, sex, education (yrs), disease duration (yrs), number of comorbid conditions (depression, diabetes, hypertension, stroke, musculoskeletal problems, congestive heart failure, and pulmonary, neurologic and cardiovascular conditions), and number of DMARD at the last HAQ. The DMARD included in these analyses were almost entirely pre-biologics. Multivariable analyses were performed in a staged manner to separate the contributions of covariates to group differences. Statistical analyses were performed using SAS software (SAS, Cary, NC, USA), v. 8.2 on the Windows platform. In accord with SAS procedures, missing data were not included in analyses. Significance was set at $p < 0.05$. Results are reported as mean (standard error [SE]).

RESULTS

Patient characteristics. The timeframe for the last questionnaire data ranged from 1981 through 2003. On average across the 3 groups, a small proportion of the data (~14%) was derived from questionnaire responses prior to 1990, with the remaining data obtained between 1990 and 2003. The ethnic groups were relatively similarly distributed among databank centers, with the exception that there were higher numbers of Hispanics in the Wichita databank. However, there were no indications that patients in any of the ethnic groups were different or more or less likely to be enrolled or continue participation.

Table 1 presents the characteristics of the 4730 patients with RA in the cohort. Patients were predominantly Caucasian (91%), and the majority were female (76%). Caucasians were significantly older, in their early 60s, as compared to each ethnic group, who were in their mid-50s (both $p < 0.0001$ from Caucasians). There were significantly higher proportions of

Table 1. Patient characteristics at last questionnaire. p values are for differences between Caucasians vs African Americans and Caucasians vs Hispanics.

	Caucasian, n = 4294	African American, n = 283	Hispanic, n = 153
Females, %	75.3	85.9***	78.4***
Age, yrs[1]	61.5 (0.22)	56.1 (0.91)***	55.4 (1.1)***
Education, yrs[1]	13.1 (0.04)	12.2 (0.17)***	11.8 (0.29)***
Age at onset, yrs[1]	46.7 (0.25)	44.7 (1.02)	40.9 (1.2)***
Disease duration, yrs[1]	15.5 (0.19)	13.3 (0.76)**	14.6 (0.96)
Comorbidities, N[1,2]	1.8 (0.02)	1.9 (0.08)	1.8 (0.10)
DMARD, N[1]	1.6 (0.02)	1.4 (0.06)**	1.4 (0.07)*

[1] mean (standard error). [2] Comorbidities: depression, diabetes, hypertension, stroke, musculoskeletal problems and pulmonary, neurologic, and cardiovascular conditions and congestive heart failure. DMARD: disease modifying antirheumatic drugs. * $p < 0.05$, ** $p < 0.01$, ***$p < 0.0001$.

women in each ethnic group as compared to Caucasians ($p < 0.0001$). Caucasian patients with RA also had significantly more education, with 13 years of schooling versus 12 for African Americans, and ~12 years for Hispanics (both $p < 0.0001$ from Caucasians). Age of RA onset was the oldest and RA disease duration the longest for Caucasians, although the difference was statistically distinguishable only from Hispanics for age at onset (47 vs 41 yrs old; $p < 0.0001$) and African Americans for disease duration (16 vs 13 yrs; $p < 0.001$). The number of comorbid conditions and DMARD were similar across groups, but there was slightly higher use of DMARD by Caucasian patients with RA compared to both African Americans and Hispanics ($p < 0.01$ and $p < 0.05$). In sum, Hispanics were the youngest, least educated, and had developed their RA earlier than Caucasians or African Americans. Caucasians were the oldest, best educated, oldest at disease onset, had their RA the longest, and had slightly more DMARD use.

Table 2 shows the unadjusted and adjusted results by ethnic group. Unadjusted scores suggested some disparity between Caucasians (1.24) compared with African Americans (1.28) and Caucasians with Hispanics (1.30) in disability, but differences were not statistically different. Pain scores for both African Americans and Hispanics were significantly worse than Caucasians ($p < 0.01$). Global health scores were worse for both ethnic groups compared to Caucasians, but only statistically different for Hispanics ($p < 0.05$). For all 3 measures, Hispanics had the worst scores.

Disparities in disability. Results of the multivariable analysis of covariance for HAQ-DI scores revealed some significant disparities that were not apparent in the raw data. These analyses first controlled for databank center, age, and sex, then successively added education, disease duration, number of comorbid conditions (entered individually), and number of DMARD at the last questionnaire. Effects of adding databank center, age, and sex to the model showed differences for both African Americans and Hispanics, but were not significantly different from Caucasians ($p > 0.05$). Adding education to the model attenuated these disparities, indicating that some of the Caucasian group advantage was associated with higher education levels, although the difference between African Americans and Hispanics was small. Adjusting for disease duration and number of comorbidities increased differences between Caucasians and African Americans and with

Table 2. Unadjusted and adjusted disability, pain, and global health scores at last questionnaire for Caucasians (n = 4294), African Americans (n = 283), and Hispanics (n = 153). p values are for differences between Caucasians vs African Americans and Caucasians vs Hispanics. Data are mean (SE).

	HAQ Disability Index (0–3; 3 = unable to do)			Pain (0–100; 100 = worst pain)			Global Health (0–100; 100 = worst health)		
	Caucasian	African American	Hispanic	Caucasian	African American	Hispanic	Caucasian	African American	Hispanic
Unadjusted scores	1.24 (0.01)	1.28 (0.05)	1.30 (0.07)	33.3 (0.44)	39.3 (1.9)**	41.7 (2.7)**	39.3 (0.42)	42.4 (1.7)	43.7 (2.1)*
Adjusted scores									
Databank center, age, sex	1.23 (0.02)	1.32 (0.05)	1.35 (0.07)	30.6 (0.67)	37.5 (1.7)***	39.5 (2.4)***	39.8 (0.65)	43.2 (1.7)	44.4 (2.3)*
+ Education	1.23 (0.02)	1.26 (0.05)	1.22 (0.07)	30.0 (0.68)	34.8 (1.8)*	35.2 (2.5)*	39.8 (0.67)	41.5 (1.7)	40.3 (2.4)
+ Disease duration	1.19 (0.03)	1.24 (0.06)	1.19 (0.07)	30.9 (0.91)	35.6 (2.1)*	36.1 (0.6)*	40.5 (0.86)	41.8 (2.0)	41.0 (2.5)
+ Comorbidities[1]	1.20 (0.03)	1.28 (0.06)	1.22 (0.07)	32.0 (0.90)	38.3 (2.1)**	38.1 (2.5)*	41.1 (0.84)	43.0 (2.0)	42.0 (2.4)
+ DMARD	1.16 (0.03)	1.31 (0.08)	1.18 (0.08)	30.3 (1.1)	37.4 (2.9)*	34.3 (3.1)	40.4 (1.0)	42.9 (2.8)	40.5 (2.9)

[1] Comorbidities: depression, diabetes, hypertension, stroke, musculoskeletal problems, and pulmonary, neurologic and cardiovascular conditions and congestive heart failure. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.005$.

Hispanics, indicating that the number of years with RA and presence of comorbid conditions may be factors contributing to disability experienced by the groups; however, these were statistically indistinguishable from Caucasians ($p > 0.05$). Finally, addition of DMARD use showed an increase in the disparity between African Americans and Caucasians ($p > 0.05$), while it decreased the difference between Hispanics and Caucasians ($p > 0.05$), indicating that treatment differences may play a larger role in this group of African Americans than Hispanics when compared with Caucasians. In the final model, Caucasians had the least amount of disability. African Americans were the most disabled, with Hispanics falling in between and closer to Caucasians.

Disparities in pain scores. Sequential adjustments in the model for pain show that both groups were substantially discordant from Caucasians at all levels. Statistical modeling was performed for pain scores similar to disability, having first controlled for databank center and demographic factors, then successively adding education, disease duration, comorbid conditions, and DMARD use. The differences from Caucasians were statistically different after controlling for databank center, age, and sex ($p < 0.005$) in both ethnic groups. Education and disease duration also showed some effects for both African Americans and Hispanics ($p < 0.05$). Adjustment for comorbidities showed statistical differences from Caucasians in both ethnic groups ($p < 0.01$ for African Americans, $p < 0.05$ for Hispanics). In the full model, the pain score was significantly higher ($p < 0.05$) in African Americans versus Caucasians. In Hispanics, the difference from Caucasians narrowed in the final model, with the largest effect seen after adjustment for the number of DMARD. Overall, the results for pain were similar to that of disability: Caucasians fared best, African Americans had the worst outcome, and Hispanics were in between.

Disparities in global health status. There were relatively few statistical differences between Caucasians and African Americans or Hispanics after adjusting for covariates in global health status. Statistical modeling was performed for global health scores similar to disability and pain, having first controlled for databank center and demographic factors, then successively adding education, disease duration, comorbid conditions, and DMARD use. Only databank center, age, and sex adjustments were significantly different from Caucasians in Hispanics ($p < 0.05$). In the final model, however, again, African Americans fared the worst, whereas Caucasians and Hispanics were similar.

DISCUSSION

This is one of the few studies that has explored the role of disability, pain, and global health PRO as potential contributing factors to health disparities in minority patients with RA. The findings in this initial exploratory cross-sectional study suggest that in a cohort of patients with RA who are relatively similar demographically, minority health disparities exist. Adjusting for demographic and other covariates had permitted identification of differences that otherwise might have been missed. After controlling for possible contributing factors, for all 3 measures both Hispanics and African Americans had poorer outcomes than Caucasians, with African Americans having the worst, although differences in disability and global health showed no statistical significance.

It was not surprising to find that African Americans and Hispanics had for the most part poorer health outcomes than Caucasians. Many studies have shown that Caucasians fare better than non-Caucasians in mortality and morbidity status for many major chronic illnesses[1,8]. It is also recognized that African Americans and Hispanics experience substantial and as yet largely unexplained health disparities compared to Caucasians[22], albeit there are sparse data on whether and how patients with RA in particular are affected.

Both ethnic minority groups in this study were less educated than Caucasians, which may have played an important role in these findings, possibly by functioning as a surrogate for socioeconomic status. This is consistent with the large body of evidence demonstrating that lower educational attainment is a risk factor for poorer health outcomes[23]. In patients with RA, as well, lower educational attainment in RA has been found to adversely influence outcomes[24,25].

Increasing or older age is also often a dominant risk factor for adverse health outcomes, and it is highly plausible that age could have an effect. Yet in our study Caucasians were significantly older. They also had their disease for the longest time, which should have worked to their disfavor. The number of comorbid conditions could also have affected health outcomes, although these were similar across groups. Significant effects of the number of comorbid conditions were seen in African Americans and Hispanics for pain, suggesting that other health problems may be contributing to poorer health status.

There are a number of potential limitations with the current research. This was a preliminary cross-sectional examination of ARAMIS data, so it was not possible to examine cause and effect. It represented an initial exploration to determine whether additional longitudinal study is warranted and to suggest hypotheses to be tested. The data are based on self-report and thus may be subject to misreport and confounding. However, HAQ self-report data have been shown to be reliable. They have been validated in hundreds of studies since the HAQ's inception 3 decades ago[21]. In addition, extensive data indicate that self-report measures provide important and clinically useful information that in some cases, such as pain, may not be obtained by "objective" methods[26]. Also, the study results were derived from ARAMIS patient data, which may not be generalizable to all other patients with RA, although they have been shown to be similar to typical patients with RA seen in clinics[18]. Moreover, these patients on average had had their RA for several years. Thus, they may differ from patients who are early in the disease course and who may now be bet-

ter able to avail themselves of newer and improved treatment earlier after disease onset. On the other hand, this cohort provided an opportunity to look at minority differences in a group with small amounts of variation in some possible contributory factors.

Our study is among the first to examine the PRO of disability, pain, and global health between Caucasian and African American and Caucasian and Hispanic patients with RA in a relatively similar cohort. These findings suggest that there are ethnic disparities, with Caucasians faring better on all 3 of the outcomes studied here. Additional study and longitudinal research with larger numbers of patients are needed to improve the understanding of these differences and to assess potential causal roles of chronic disease risk factors, medication use, and comorbid conditions. Further exploration into access to care and healthcare utilization issues is also warranted.

Health disparities in minority patients with RA have been less well studied than those of patients with other rheumatic diseases. The elimination of these disparities ultimately requires comprehensive efforts to describe the characteristics that influence RA among minority patients. Understanding the patterns and the burden of disease among minority groups with RA will contribute to the understanding of RA and may lead to improved treatment and prevention strategies.

REFERENCES

1. Smedley B, Stith AY, Nelson AR, editors. Unequal treatment: Confronting racial and ethnic disparities in health care. Washington DC: National Academies Press; 2002.
2. Department of Health and Human Services (US). Healthy People 2010. Understanding and improving health. 2nd ed. Washington, DC: US Government Printing Office; 2000.
3. McBean AM, Li S, Gilbertson DT, Collins AJ. Differences in diabetes prevalence, incidence, and mortality among the elderly of four racial/ethnic groups: whites, blacks, hispanics, and asians. Diabetes Care 2004;2:2317-24.
4. Alarcon GS, Roseman J, Bartolucci AA, et al. Systemic lupus erythematosus in three ethnic groups: II. Features predictive of disease activity early in its course. LUMINA Study Group. Lupus in Minority Populations, Nature Versus Nurture. Arthritis Rheum 1998;41:1173-80.
5. Reveille JD, Moulds JM, Ahn C, et al. Systemic lupus erythematosus in three ethnic groups: I. The effects of HLA class II, C4, and CR1 alleles, socioeconomic factors, and ethnicity at disease onset. LUMINA Study Group. Lupus in Minority Populations, Nature Versus Nurture. Arthritis Rheum 1998;41:1161-72.
6. Reveille JD, Fischbach M, McNearney T, et al. Systemic sclerosis in 3 US ethnic groups: a comparison of clinical, sociodemographic, serologic, and immunogenetic determinants. Semin Arthritis Rheum 2001;30:332-46.
7. Laing TJ, Gillespie BW, Toth MB, et al. Racial differences in scleroderma among women in Michigan. Arthritis Rheum 1997;40:734-42.
8. Jordan JM, Lawrence R, Kington R, et al. Ethnic health disparities in arthritis and musculoskeletal diseases: report of a scientific conference. Arthritis Rheum 2002;46:2280-6.
9. Lawrence RC, Helmick CG, Arnett FC, et al. Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. Arthritis Rheum 1998;41:778-99.
10. Jordan JM. Effect of race and ethnicity on outcomes in arthritis and rheumatic conditions. Curr Opin Rheumatol 1999;11:98-103.
11. Dominick KL, Dudley TK, Grambow SC, Oddone EZ, Bosworth HB. Racial differences in health care utilization among patients with osteoarthritis. J Rheumatol 2003;30:2201-6.
12. OMERACT. Conference on Outcome Measures in Rheumatoid Arthritis Clinical Trials. Proceedings. J Rheumatol 1993;20:527-91.
13. Felson DT, Anderson JJ, Boers M, et al. The American College of Rheumatology preliminary core set of disease activity measures for rheumatoid arthritis clinical trials. The Committee on Outcome Measures in Rheumatoid Arthritis Clinical Trials. Arthritis Rheum 1993;36:729-40.
14. Ward MM, Leigh JP. The relative importance of pain and functional disability to patients with rheumatoid arthritis. J Rheumatol 1993;20:1494-9.
15. Brown JH, Kazis LE, Spitz PW, Gertman P, Fries JF, Meenan RF. The dimensions of health outcomes: a cross-validated examination of health status measurement. Am J Public Health 1984;74:159-61.
16. Kazis LE, Meenan RF, Anderson JJ. Pain in the rheumatic diseases. Investigation of a key health status component. Arthritis Rheum 1983;26:1017-22.
17. Fries JF, Ramey DR. "Arthritis specific" global health analog scales assess "generic" health related quality-of-life in patients with rheumatoid arthritis. J Rheumatol 1997;24:1697-702.
18. Arthritis, Rheumatism, and Aging Medical Information System (ARAMIS). Available at: http://aramis.stanford.edu (accessed April 4, 2007).
19. Fries JF, Spitz P, Kraines RG, Holman HR. Measurement of patient outcome in arthritis. Arthritis Rheum 1980;23:137-45.
20. Bruce B, Fries JF. The Arthritis, Rheumatism and Aging Medical Information System (ARAMIS): still young at 30 years. Clin Exp Rheumatol 2005;23 Suppl 39:S163-7.
21. Bruce B, Fries J. The Stanford Health Assessment Questionnaire: a review of its history, issues, progress, and documentation. J Rheumatol 2003;30:167-78.
22. House J, Williams D, editors. Understanding and reducing socioeconomic and racial/ethnic disparities in health. Washington, DC: National Academy Press; 2000.
23. Bridges SL Jr, Hughes LB, Mikuls TR, et al. Early rheumatoid arthritis in African-Americans: the CLEAR Registry. Clin Exp Rheumatol 2003;21 Suppl 31:S138-45.
24. Pincus T, Callahan LF. Formal education as a marker for increased mortality and morbidity in rheumatoid arthritis. J Chron Dis 1985;38:973-84.
25. Wolfe F, Lane NE. The longterm outcome of osteoarthritis: rates and predictors of joint space narrowing in symptomatic patients with knee osteoarthritis. J Rheumatol 2002;29:139-46.
26. Fries JF. Toward an understanding of patient outcome measurement. Arthritis Rheum 1983;26:697-704.