



Combined effect of individual and neighbourhood socioeconomic status on mortality of rheumatoid arthritis patients under universal health care coverage system

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Abstract

Background. The National Health Insurance program in Taiwan is a public insurance system for the entire population of Taiwan initiated since March 1995. However, the association of socioeconomic status (SES) and prognosis of rheumatoid arthritis (RA) patients under this program has not been identified.

Objectives. Using the National Health Insurance Research Database in Taiwan, we aimed to examine the combined effect of individual and neighbourhood SES on the mortality rates of RA patients under a universal health care coverage system.

Measures. A study population included patients with RA from 2004 to 2008. The primary end point was the 5-year overall mortality rate. Individual SES was categorized into low, moderate and high levels based on the income-related insurance payment amount. Neighbourhood SES was defined by household income and neighbourhoods were grouped as an 'advantaged' area or a 'disadvantaged' area. The Cox proportional hazards regression model was used to compare outcomes between different SES categories. A two-sided P value < 0.05 was considered statistically significant.

Results. Medical data of 23900 RA patients from 2004 to 2008 were reviewed. Analysis of the combined effect of individual SES and neighbourhood SES revealed that 5-year mortality rates were worse among RA patients with a low individual SES compared to those with a high SES ($P < 0.001$). In the Cox proportional hazards regression model, RA patients with low individual SES in disadvantaged neighbourhoods incurred the highest risk of mortality (Hazard ratio = 1.64; 95% confidence interval, 1.26–2.13, $P < 0.001$).

Conclusions. RA patients with a low SES have a higher overall mortality rate than those with a higher SES, even with a universal health care system. It is crucial that more public policy and

health care efforts be put into alleviating the health disadvantages, besides providing treatment payment coverage.

Key words: Health care system, mortality, national health insurance, public policy, rheumatoid arthritis, socioeconomic status.

Introduction

Rheumatoid arthritis (RA) is an autoimmune disease that affects many tissues and organs, leading to severe disability and premature mortality (1,2). RA is also the most common inflammatory arthropathy worldwide, with a prevalence of 0.5–1.0% in industrialized countries (3). In Taiwan, the annual incidence of RA was 15.8 cases per 100 000 persons and the lifespan of patients with RA was reduced by 3–12 years (2). Several factors may be associated with the prognosis of RA, including young age at onset, long disease duration, co-morbidities and characteristics and severity of RA (4). Several studies from different countries have reported that RA patients with a low socioeconomic status (SES) had worse disease activity, functional disability, physical and mental health, quality of life, and 'RA control', and higher mortality rates than patients with a high SES (5). In fact, low SES was related to a decreased or delayed utilization of health care services and resulted in a higher disease mortality risk (6). The medical costs related to treating RA are high; therefore, the health coverage system plays an important role in the utilization and efficacy of RA treatment.

The National Health Insurance (NHI) program in Taiwan is a public insurance system for the entire population of Taiwan, and was initiated in March 1995. The medical care of up to 99% of the 23 million residents of Taiwan is currently covered by the NHI program. RA is categorized as a catastrophic illness in Taiwan and patients with RA do not have to pay the copayment for outpatient or inpatient care. Using the National Health Insurance Research Database (NHIRD) in Taiwan, we aimed to examine the combined effect of individual and neighbourhood SESs on the mortality rates of RA patients under a universal health care coverage system.

Methods and materials

Study design and patient selection

This was a retrospective cohort study of a Taiwanese population of RA patients from 2004 to 2008. All data were retrieved from the NHIRD, which includes the comprehensive medical care records of over 97% of the hospitals and clinics in Taiwan. All claims data in ambulatory care records, inpatient care records and the registration files of the insured input in the NHIRD was collected by National Health Research Institute.

Patients greater than 18 years old, with a first RA diagnosis between 2004 and 2008, and with a discharge diagnosis that met the criteria of International Classification of Diseases, 9th

Revision, Clinical Modification (ICD-9-CM) codes 714 and 714.0-714.3x were recruited for this study. In the NHI program of Taiwan, the subjects with RA will have 'catastrophic illness card' and who is exempted from paying copayments. The overall mortality rate was used because cause-specific mortality rates were difficult to determine from the registry data. Patients were then linked to the mortality data for the years 2004–2008 for mortality rate calculation. Each patient was tracked from the first diagnosis until the end of 2008 or until mortality occurred, whichever was earlier. The key independent variables were the contextual effects of individual SES and neighbourhood SES. Patient characteristics including age, gender, urbanization, geographic location, comorbidities, hospital at admission and teaching level of hospital were recorded. Co-morbid conditions were identified according to the ICD-9-CM system and were further grouped into the following broad categories to construct a logistic regression model: hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, congestive heart failure, chronic kidney disease, pneumonia, chronic obstructive pulmonary disease, septicemia and shock.

Socioeconomic status

Individual-level SES

The individual SES of RA patients was defined and categorized into three levels: (i) low SES: lower than US \$528 per month (New Taiwan Dollar (NT\$) 15 840); (ii) moderate SES: between US\$528–833 per month (NT\$15 841–25 000); and (iii) high SES: US\$833 per month (NT\$25 001) or more (7,8). We selected NT\$15 840 as the low income level cut-off point because this was the government-stipulated minimum wage for full-time employees in Taiwan in 2006.

Neighbourhood-level SES

In the previous study, Winkleby *et al.* identified the following variables to characterize neighbourhood SES: percentage high-school education, median annual family income, percentage blue collar workers, percentage unemployed and median household income. We adopted median household income as a proxy of neighbourhood SES (9). For neighbourhood SES, household income was a contextual characteristic representing averages and percentages measured at the enumeration level in the 2001 Taiwan Census. Neighbourhood household income was measured using per capita personal income by township acquired

from the 2001 income tax statistics released by Taiwan's Ministry of Finance (<http://www.fdc.gov.tw>). On the basis of the median values for neighbourhood characteristics, we defined 'advantaged' neighbourhoods as having higher-than-median neighbourhood household incomes, and 'disadvantaged' neighbourhoods as having lower-than-median household incomes.

Other variables

Residential urbanization was classified into seven levels based on the population density, percentage of residents with college level or higher education, percentage of residents >65 years old, percentage of residents who were agricultural workers and the number of physicians per 100 000 people. We further classified the residential urbanization levels as urban (urbanization level 1), suburban (urbanization levels 2–3) or rural (urbanization levels 4–7). Hospitals were categorized by ownership (public, non-profit or for-profit) and hospital level (medical centre, regional or district hospital). The geographic regions in which the RA patients resided were identified and recorded as northern, central, southern and eastern Taiwan.

Statistical analysis

Data analysis was carried out using the SAS statistical package (version 9.2; SAS Institute, Inc., Cary, NC), and SPSS software (version 15, SPSS Inc., Chicago, IL). Pearson's chi-square test was used for categorical variables such as gender, level of urbanization, geographic region of residence, comorbidities and hospital characteristics (teaching level of hospital, ownership and caseload) in RA patients. Continuous variables were analysed with a one-way ANOVA test. Mortality rate, stratified by individual SES and neighbourhood SES, were measured from the time of diagnosis using overall mortality as the event variable. The cumulative 5-year mortality rates and the mortality curves were constructed and compared using the log-rank test. The Cox proportional hazards regression model, adjusted for patients' characteristics (age at diagnosis, gender, comorbidities, urbanization and geographic region of residence) and hospital characteristics (ownership, teaching level of hospital and caseload), was used to compare outcomes between different SES categories. SES variables were introduced into the Cox model with the high individual SES and advantaged neighbourhood group as the reference group. A two-sided $P < 0.05$ was considered statistically significant.

Results

Medical data of 23 900 RA patients from 2004 to 2008 were reviewed (Table 1). The mean age at diagnosis differed significantly by individual SES; it was 48 (± 14) years for the high individual SES group, 54 (± 13) years for the moderate individual

SES group, and 56 (± 18) years for the low individual SES group ($P < 0.001$). The proportion of females was significantly higher in the low and moderate individual SES group.

RA patients with a high individual SES were more likely to be younger, to reside in urban areas, especially in northern Taiwan, and to undergo treatment in medical centres compared with moderate and low individual SES counterparts ($P < 0.001$). With respect to comorbid conditions, RA patients with a high individual SES had a tendency to be more health and have lesser hypertension, diabetes, atrial fibrillation, chronic kidney disease, pneumonia, chronic obstructive pulmonary disease, septicemia and shock ($P < 0.001$), except for dyslipidemia ($P = 0.083$).

The result of a Kaplan–Meier analysis showed that patients with a low individual SES had poorer prognoses. RA patients with a high SES and residing in advantaged neighbourhoods had the best outcome (Figure 1). RA patients with a low SES and residing in either an advantaged or a disadvantaged neighbourhood had a poorer prognosis.

Analysis of the combined effect of individual SES and neighbourhood SES revealed that mortality rates were worse among RA patients with a low individual SES than among those with a high SES (9.2% versus 1.7% in advantaged neighbourhoods, 9.3% versus 2% in disadvantaged neighbourhoods ($P < 0.001$). The mortality rates of patients with a moderate SES were also higher than those of patients with a high SES. The lowest mortality rates were among patients with a high SES residing in advantaged neighbourhoods (1.7%), and the highest mortality rates were among those with a low SES residing in disadvantaged neighbourhoods (9.3%) (Table 2).

RA patients in disadvantaged neighbourhoods had fewer resources for health care (e.g. physicians per 10 000 residents and pharmacies). RA patients in advantaged neighbourhoods had a higher level of education and higher median household income (Table 3).

After adjustment for the covariates, the combined effect of individual SES and neighbourhood SES remained statistically significant in the Cox proportional hazards regression model (Table 4). Adjusted hazard ratios revealed that RA patients with a low individual SES in advantaged neighbourhoods had a higher risk of mortality [Hazard ratio (HR) = 1.78; 95% confidence interval (CI), 1.31–2.44, $P < 0.001$] than those with a high individual SES residing in advantaged neighbourhoods. Among patients with a high SES, those residing in disadvantaged neighbourhoods had a lower risk of mortality than those in advantaged neighbourhoods, but there was no statistical significance (HR = 0.81, 95% CI, 0.51–1.28).

Discussion

This population-based study examined the combined effect of individual and neighbourhood SES on the risk of all-cause

Table 1. Baseline characteristics of RA patients (n=23 900)

Variables	Individual socioeconomic status			P value
	High SES (n=4262)	Moderate SES (n=10 196)	Low SES (n=9442)	
Mean age, years (\pm SD)	48 \pm 14	54 \pm 13	56 \pm 18	<0.001
Gender				<0.001
Male (%)	1196 (28.1)	2019 (19.8)	1891 (20.0)	
Female (%)	3066 (71.9)	8177 (80.2)	7551 (80.0)	
Urbanization of residence				<0.001
Urban (%)	1727 (40.5)	2219 (21.8)	3252 (34.4)	
Suburban (%)	1951 (45.8)	4029 (39.5)	4470 (47.3)	
Rural (%)	584 (13.7)	3948 (38.7)	1720 (18.2)	
Geographic of residence				<0.001
Northern (%)	2808 (65.9)	4306 (42.2)	5709 (60.5)	
Central (%)	693 (16.3)	2394 (23.5)	1728 (18.3)	
Southern (%)	648 (15.2)	3182 (31.2)	1783 (18.9)	
Eastern (%)	113 (2.7)	314 (3.1)	222 (2.4)	
<i>Comorbidities</i>				
Hypertension				<0.001
Yes (%)	357 (8.4)	1629 (16.0)	1885 (20.0)	
No (%)	3905 (91.6)	8567 (84.0)	7557 (80.0)	
Diabetes				<0.001
Yes (%)	174 (4.1)	873 (8.6)	849 (9.0)	
No (%)	4088 (95.9)	9323 (91.4)	8593 (91.0)	
Dyslipidemia				0.083
Yes (%)	78 (1.8)	240 (2.4)	229 (2.4)	
No (%)	4184 (98.2)	9956 (97.6)	9213 (97.6)	
Atrial fibrillation				<0.001
Yes (%)	18 (0.4)	129 (1.3)	149 (1.6)	
No (%)	4244 (99.6)	10067 (98.7)	9293 (98.4)	
Congestive heart failure				<0.001
Yes (%)	39 (0.9)	325 (3.2)	386 (4.1)	
No (%)	4223 (99.1)	9871 (96.8)	9056 (95.9)	
Chronic kidney disease				<0.001
Yes (%)	34 (0.8)	154 (1.5)	180 (1.9)	
No (%)	4228 (99.2)	10042 (98.5)	9262 (98.1)	
Pneumonia				<0.001
Yes (%)	155 (3.6)	816 (8.0)	947 (10.0)	
No (%)	4107 (96.4)	9381 (92.0)	8495 (90.0)	
Chronic obstructive pulmonary disease				<0.001
Yes (%)	111 (2.6)	591 (5.8)	684 (7.2)	
No (%)	4151 (97.4)	9605 (94.2)	8758 (92.8)	
Septicaemia				<0.001
Yes (%)	89 (2.1)	602 (5.9)	677 (7.2)	
No (%)	4173 (97.9)	9594 (94.1)	8765 (92.8)	
Shock				<0.001
Yes (%)	43 (1.0)	274 (2.7)	321 (3.4)	
No (%)	4219 (99.0)	9922 (97.3)	9121 (96.6)	
<i>Hospital characteristics</i>				
Teaching level				<0.001
Medical center (%)	2645 (62.1)	5578 (54.7)	5845 (61.9)	
Regional (%)	1083 (25.4)	3069 (30.1)	2386 (25.3)	
District (%)	175 (4.1)	268 (2.6)	304 (3.2)	
Others (%)				

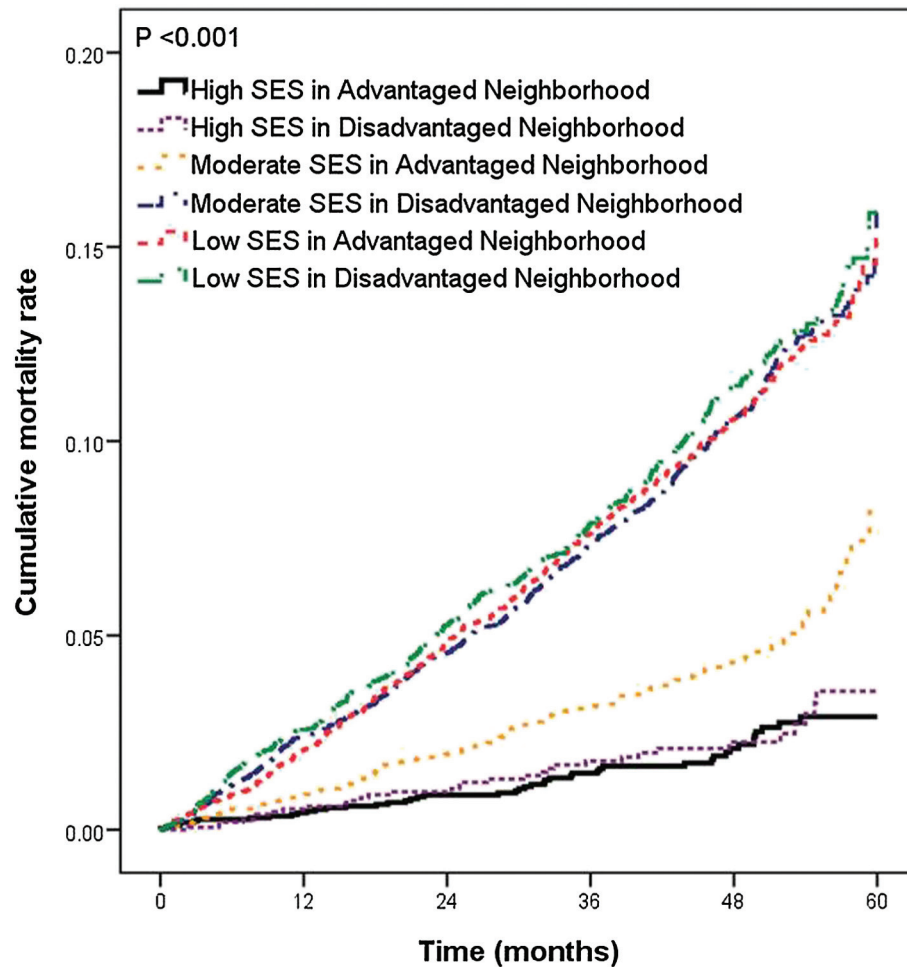


Figure 1. The combined effect of individual and neighbourhood SES on mortality rates in RA patients.

mortality among RA patients in a national health insurance system. Our results showed SES was significantly associated with disease outcome. Patients with a low or moderate individual SES had higher all-cause mortality than patients with a high SES after adjusting the baseline characteristics of RA patients and sociodemographic characteristics of individual and neighbourhood SES. After adjustment, patients with a low individual SES residing in advantaged neighbourhoods had a higher risk of death than those with a high SES living in advantaged neighbourhoods (5-year mortality rate = 9.2%; HR = 1.78, 95% CI, 1.31–2.443, $P < 0.001$). There are only differences in individual SES, but not the neighbourhood SES. The results revealed that even under a universal health care coverage system, RA patients with a low SES still had a poorer prognosis.

The interesting issue is that of the interplay between insurance coverage, SES and disease outcome. The treatment for RA includes primarily non-steroidal anti-inflammatory drugs and disease-modifying anti-rheumatic drugs, as well as biologic drugs, rehabilitation measures and orthopaedic surgery. Lifelong treatment duration is always necessary. Therefore,

the costs associated with treatment of RA are relatively high, approximating those of coronary artery disease (10). In terms of cost-sharing for medical services, ill patients were less likely to seek help or be admitted to hospitals if they had to pay a portion of the cost (11). There was evidence in a previous study to suggest that patients who are uninsured tend to have a lower SES, and uninsured hospitalized patients also tend to have shorter hospital stays (12). The current NHI health care system in Taiwan aimed to eliminate primary health inequality. The system promises equal access to health care for all citizens and plays an important role closing the gap in medical accessibility between different SES groups (13). RA was further categorized as a ‘catastrophic illness’ in Taiwan and patients with a catastrophic illness certification who seek care for their illness or related conditions within the certificate’s validity period do not need to pay the copayment for outpatient or inpatient care. However, our study still shows that low-SES RA patients had a higher mortality rate. Therefore, there seem to be other factors, besides the RA treatment cost, associated with low SES that play an important role and affect the prognosis of RA.

Table 2. Combined effect of individual SES and neighbourhood SES on 5-year overall mortality rates ($n = 23900$)

Neighbourhood socioeconomic status	Individual socioeconomic status						P value
	High SES		Moderate SES		Low SES		
	n	Death (%)	n	Death (%)	n	Death (%)	
RA							<0.001
Advantaged	2658	46 (1.7)	3831	152 (4.0)	5285	484 (9.2)	
Disadvantaged	1604	32 (2.0)	6365	558 (8.8)	4157	388 (9.3)	

Table 3. Sociodemographic characteristics of RA patients by individual and neighbourhood socioeconomic status ($n = 23900$)

	High individual SES		Moderate individual SES		Low individual SES		P value*
	Advantaged neighbourhood	Disadvantaged neighbourhood	Advantaged neighbourhood	Disadvantaged neighbourhood	Advantaged neighbourhood	Disadvantaged neighbourhood	
Number of patients	2658	1604	3831	6365	5285	4157	
Number of deaths (%)	46 (1.7)	32 (2.0)	152 (4.0)	558 (8.8)	484 (9.2)	388 (9.3)	<0.001
Mean age, mean \pm SD	48 \pm 16	49 \pm 10	50 \pm 11	57 \pm 13	57 \pm 17	54 \pm 18	<0.001
Male gender, %	25.7	32.0	17.0	21.5	19.1	21.2	<0.001
Median household income, NT\$1000	626 \pm 73	498 \pm 33	601 \pm 57	481 \pm 38	622 \pm 68	493 \pm 35	<0.001
Health care-related resources							
Physicians per 10000 persons, mean \pm SD	27 \pm 22	12 \pm 11	25 \pm 19	10 \pm 10	25 \pm 20	11 \pm 11	<0.001
Pharmacists per 10000 persons, mean \pm SD	10 \pm 12	4 \pm 3	7 \pm 7	3 \pm 3	9 \pm 12	3 \pm 3	<0.001

*Pearson's chi-square test was used for categorical variables analysis; one-way ANOVA test was used for continuous variables analysis.

Table 4. Hazard ratios of individual SES for mortality in advantaged and disadvantaged neighbourhoods^a ($n=23900$)

Neighbourhood socioeconomic status	Individual socioeconomic status					
	High SES		Moderate SES		Low SES	
	Adjusted HR	95% CI	Adjusted HR	95% CI	Adjusted HR	95% CI
RA						
Advantaged	1		1.45	1.04–2.03	1.78	1.31–2.44
Disadvantaged	0.81	0.51–1.28	1.45	1.05–2.01	1.58	1.15–2.17

^aAdjusted for the patients' gender, age, urbanization, geographic region, comorbidities and hospital characteristics.

There are possible interpretations for this phenomenon of increasing mortality among RA patients with a low SES, even under universal health care coverage. First, the increased mortality rate of RA patients from cardiovascular disease (CVD), especially ischaemic heart disease, has been consistently reported in previous studies (14,15). The relationship between the increased risk of CVD and low SES has also been reported (16). In fact, RA and CVD share common pathophysiological mechanisms, such as systemic and chronic inflammation (1,14,17). Among RA patients with low SES, risk factors for CVD, including dyslipidemia, metabolic syndrome, diabetes mellitus and hypertension,

were increased, leading to secondary accelerated atherosclerosis that might explain the high mortality rates and augmented risk of ischemic events in RA patients (18).

Second, previous research has shown that the health care utilization rate among patients with a low SES was lower than that among patients with a high SES (5,12). The results showed that the mean age at diagnosis of RA in the low SES group was significantly older than that of the high SES group (56 \pm 18 versus 49 \pm 14 years old). This may reveal a situation in which the diagnosis of RA is delayed in low-SES patients. In practice, we found that patients from more deprived areas

consulted their general practitioner only when the disease was progressive and severe, whereas those in more affluent neighbourhoods may consult a doctor with milder symptoms, even though income inequality is no longer a barrier to medical care in Taiwan. The uneven distribution of rheumatologic specialists in Taiwan may be an explanation for this phenomenon. Despite the NHI's efforts to equalize the distribution of clinical physicians, most rheumatologists are still found in medical centres, which are situated mainly in Taiwan's urban areas. This reality might delay the accurate diagnosis of RA and influence the treatment (19,20). Similar idea has been addressed by Micheal M. Ward in his study which stated that the lower risk of avoidable hospitalizations at medical centres may represent better outpatient care by physicians at these medical centres (21).

Third, some adverse lifestyle factors (e.g. lack of exercise, smoking and malnutrition) and less compliance of medical order are found more often in patients with a low SES, and this may exacerbate the severity of RA and worsen the disease outcome (22). Although we use level of urbanization, geographic regions of residence and hospital characteristics as adjustment, inequalities are still present, most often related to educational level rather than income (23). Lifestyle factors may be part of the explanation. However, we could not examine these hypotheses in this study. We suggest further studies to obtain evidence to support or negate these hypotheses.

Despite these findings, there were some limitations in our study. First of all, SES is a complex indicator that may influence disease outcome. A previous study reported that patients with inflammatory polyarthritis and a low SES have significantly worse outcomes than those with a high SES. However, after adjusting for learned helplessness, the association between SES and disease outcome was no longer statistically significant (24). SES was determined mainly by differences in income in our study; some patient characteristics such as age, gender, comorbidities, urbanization, area of residence and teaching level of hospital were adjusted during analysis, but data on other confounding factors such as occupation, lifestyle (i.e. smoking, alcohol and exercise), nutritional status and psychiatric characteristics were unavailable and not taken into account. Therefore, more comprehensive adjustment of variables or more objective indices may be needed in future studies. Second, the criteria set for RA was redefined in 2010 and approved by the American College of Rheumatology (ACR) and European League Against Rheumatism (EULAR) Executive Committee, since the 1987 classification criteria for RA had been criticized for lack of sensitivity to early disease. The RA diagnoses for the period 2004–08 in our study were based on the 1987 ACR criteria, and therefore diagnoses of early RA might be missing (25). Third, the follow-up duration was not the same to all study patients that may distort the statistical analyses and

results. Finally, as mentioned above, deaths outside the hospital might not be included in the NHIRD. In fact, the absence of linkage with a mortality dataset due to official and legal restrictions also limits an in-depth approach to cause of death. This may lead to an over-estimation of the mortality rate if some deaths are not related to RA.

Conclusion

Under Taiwan's NHI program, the financial barriers to medical care have been reduced considerably. However, our investigation still showed that RA patients with a low individual SES have a higher overall mortality rate than those with a higher individual SES, even with a universal health care system. It is crucial that more public policy efforts be put into health care to alleviate the health disadvantages of RA patients with a lower SES, in addition to covering payment for treatment.

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Conflict of interest: none.

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