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## Visits to rheumatologists for arthritis: The role of access to primary care physicians, geographic availability of rheumatologists, and socioeconomic status

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# Visits to Rheumatologists for Arthritis: The Role of Access to Primary Care Physicians, Geographic Availability of Rheumatologists, and Socioeconomic Status

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**Objective.** This multilevel study examines access to rheumatologists for all arthritis and inflammatory arthritis, taking into account geographic availability of rheumatologists, access to primary care physicians (PCPs), and population characteristics (e.g., socioeconomic status [SES]).

**Methods.** We analyzed data from the population (age  $\geq 18$  years) living in the 105 health planning areas in Ontario, Canada on visits to physicians for arthritis and musculoskeletal disorders. Using data from a survey of rheumatologists and Geographic Information System analysis, an index of geographic availability for rheumatologists was calculated, incorporating distance between the population and rheumatologist locations and the number of hours per week of rheumatologist care. Multilevel Poisson regression was used to examine factors associated with the rates of rheumatology visits for inflammatory arthritis and all arthritis.

**Results.** Controlling for age and sex, the rheumatologist availability index was associated with visit rates for all arthritis, but not inflammatory arthritis. Patients living in areas with low access to PCPs or low SES were less likely to have office visits to rheumatologists for all arthritis and inflammatory arthritis.

**Conclusion.** Besides potential deficiencies in rheumatology provision, there may be access barriers to rheumatology services, particularly for populations with low access to PCPs or low SES. This is of special concern for patients with inflammatory arthritis for whom rheumatologist care is necessary. In developing models of care for arthritis, this study points to the need to pay attention to areas with low PCP resources and areas of low SES, as well as the location and amount of rheumatology services available.

## INTRODUCTION

Adequate patient access to rheumatologists is critical given the importance of early treatment of rheumatoid arthritis (RA) with disease-modifying antirheumatic drugs (DMARDs) and biologic agents. There is a critical window of opportunity where aggressive intervention with DMARDs has been shown to improve clinical outcomes, functional status, and quality of life (1), as well as decrease job loss and reduce sick leave (2). Furthermore, delays in

initiating therapy have been associated with worse outcomes (3). As disease-modifying therapy is rarely initiated by primary care physicians (PCPs) (4–7), attention has focused on the importance of timely access to rheumatologists, particularly for rheumatoid and other forms of inflammatory arthritis (8). However, a full appreciation of access to rheumatologists for the treatment of inflammatory arthritis needs to be set within a wider context.

In health care systems such as in Canada, where with universal health insurance PCPs have a gatekeeper role,

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## Significance & Innovations

- Patients with inflammatory arthritis living in areas of low socioeconomic status or with a low provision of primary care services were less likely to see a rheumatologist.
- Higher availability of rheumatologists was associated with higher visit rates to rheumatologists for all arthritis, but not for inflammatory arthritis.
- Patients with noninflammatory arthritis are likely to be seen by rheumatologists only in those areas where there is adequate availability of rheumatologists.

PCPs are usually the first contact for patients with inflammatory arthritis. However, early diagnosis of these conditions by PCPs and subsequent referral to a rheumatologist remains a challenge and a major contributor to delays in initiation of disease-modifying therapy (3,9,10). Studies have shown that PCPs may not feel confident about their ability to diagnose arthritis, which may limit their willingness to initiate referral to rheumatologists or to manage RA with DMARDs (4,5). In addition, shortages of rheumatologists and long waiting lists may act as barriers to referral (11–13).

Strategies to promote timely access to rheumatologists have focused on efforts to identify patients with early RA in the community and on educational programs at the primary care level to identify patients with potential inflammatory arthritis to promote referral and triage, as well as on initiatives to prioritize referred patients to see a rheumatologist (3,8). Less attention has been paid to the question of availability and accessibility of rheumatology services. There is some evidence that perceptions of low availability of specialists and long travel distances may deter referral (14,15). Regional variability in availability of rheumatologists may be exacerbated by regional variations in need, such as the age structure of the population. Indeed, this has been used for estimating need for rheumatologists in the US (11). Other factors associated with potential need, but not usually considered, include socioeconomic status (SES), which is associated with access to health care and to specialists in particular (16,17). Furthermore, individuals of low SES have a higher risk of developing RA, and RA is more prevalent in rural areas (18).

Understanding patterns of care for patients with inflammatory arthritis is important for targeting interventions and improving access to care in the population. The purpose of this study was to examine the per capita rate of visits to rheumatologists as an indicator of access to care within health planning regions of Ontario, Canada for all arthritis and inflammatory arthritis. The analyses considered access to PCPs, an index of geographic availability of rheumatologists, and population characteristics, including SES.

## MATERIALS AND METHODS

**Setting and study design.** The setting for this population-based, multilevel study is the 105 health planning areas (administrative areas known as sub-Local Health Integration Networks) in Ontario, Canada. The Ontario Health Insurance Plan (OHIP) provides universal coverage to Ontarians for all medically necessary hospital and physician services with no copayments or other patient charges. Access to specialists is by referral from other physicians, usually PCPs. There are no restrictions on the location and type of specialists to whom referral can be made. The majority of physicians operate on a fee-for-service basis; a claim is submitted to the provincial health insurance plan for each patient encounter. We have data for all individuals age  $\geq 18$  years with musculoskeletal disorders in Ontario, Canada who visited any type of physician, including rheumatologists, in the fiscal year 2007–2008 (April 1, 2007 to March 31, 2008). This represents all visits in the province (19,20).

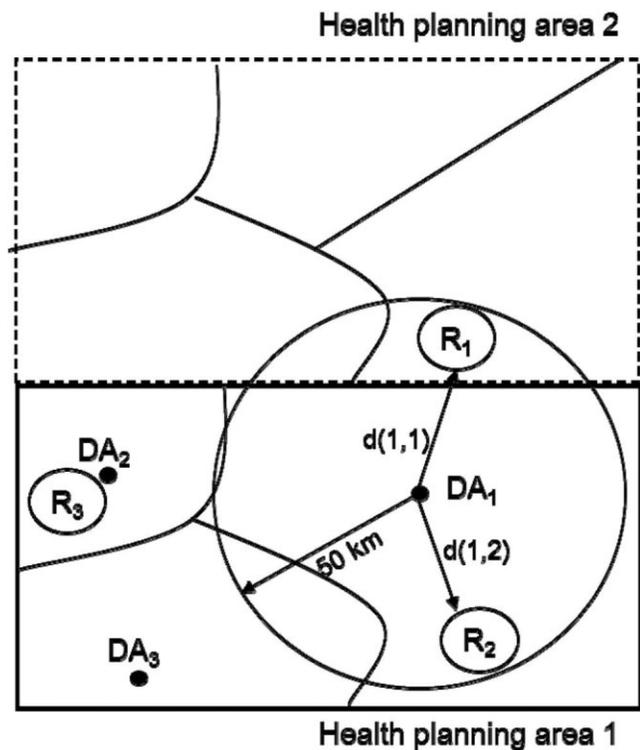
**Data sources and variables.** The Registered Persons Database was linked to the OHIP physician billing database and provided data, by health planning area, on the number by age and sex of patients with at least 1 office visit to a physician for all arthritis (inflammatory arthritis, osteoarthritis, soft-tissue disorders, traumatic arthritis, and “other arthritis”), and for inflammatory arthritis (rheumatoid arthritis, Still’s disease, ankylosing spondylitis, disseminated lupus erythematosus, scleroderma, polyarteritis nodosa, and temporal arteritis) (20–22). For a detailed list of available codes related to arthritis, see Supplementary Table 1, available in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/acr.22413/abstract>. Data on the number of patients with office visits to PCPs with diagnostic codes relevant to musculoskeletal disorders were also extracted (20–22). The Institute of Clinical Evaluative Sciences Physician Database was linked to the OHIP database to identify physician specialty for each visit. Physicians were classified as rheumatologists, PCPs, or other physicians. All claims made by the same physician on the same date for the same patient were considered 1 visit.

**Population characteristics.** Statistics Canada 2006 Census data were used to calculate indicators of SES, age of the population (proportion age  $\geq 65$  years), and proportion of rural population for each health planning area. SES was calculated by combining the median household income with the proportion of the population with less than a high school education. Both components were standardized into a z score and combined into an overall score (23). Age and SES indicators were categorized in quintiles to facilitate interpretation. Given the urban–rural distribution in Ontario, the proportion of rural population was categorized as  $<15\%$ ,  $15\text{--}49\%$ , and  $\geq 50\%$ .

**Access to PCPs.** As no data were available on the volume of care provided by PCPs in each health planning area, the rate of individuals visiting PCPs for musculoskeletal disorders was used as a proxy measure of access within each health planning area. The measure was cate-

gorized into quintiles for simplicity of presentation. Given that patients with musculoskeletal disorders comprise a high proportion of all patients seen by PCPs, this measure likely reflects actual access to PCPs in this population (20,21).

*Index of geographic availability of rheumatologists.* Data on postal codes of all rheumatologist practice locations and the number of clinic hours per week at each location were extracted from a 2007 survey of Ontario rheumatologists (24). Practice locations were geo-coded using Geographic Information System (GIS) software (25) and assigned to a dissemination area (DA). DAs are the smallest geographic units for which census data are available (there are 19,777 DAs in Ontario). A geographic availability index was derived for each health planning area using a gravity model (26). In the first step, working from each DA population centroid, distance from each rheumatologist location to each DA population centroid was calculated using the Minkowski metric (27), which has been found to be a good approximation to the road distance. A sum of the clinical hours available from rheumatologists weighted by the inverse of the squared distance from the population to all rheumatologist locations within a reasonable distance (we used 50 km) was calculated (Figure 1 illustrates the spatial calculation of the index). The inverse



$$Index\ for\ DA_1 = \frac{R_1(hours)}{d(1,1)^2} + \frac{R_2(hours)}{d(1,2)^2} \times 100,000$$

Figure 1. Spatial representation of the calculations of the index of geographic availability of rheumatologists. DA = dissemination area with population centroid marked with a dot; R = location where rheumatologist services are provided.

**Table 1. Use of rheumatology services, access to primary care physicians (PCPs), and rheumatologists' availability across health planning areas (n = 105); Ontario, fiscal year 2007–2008\***

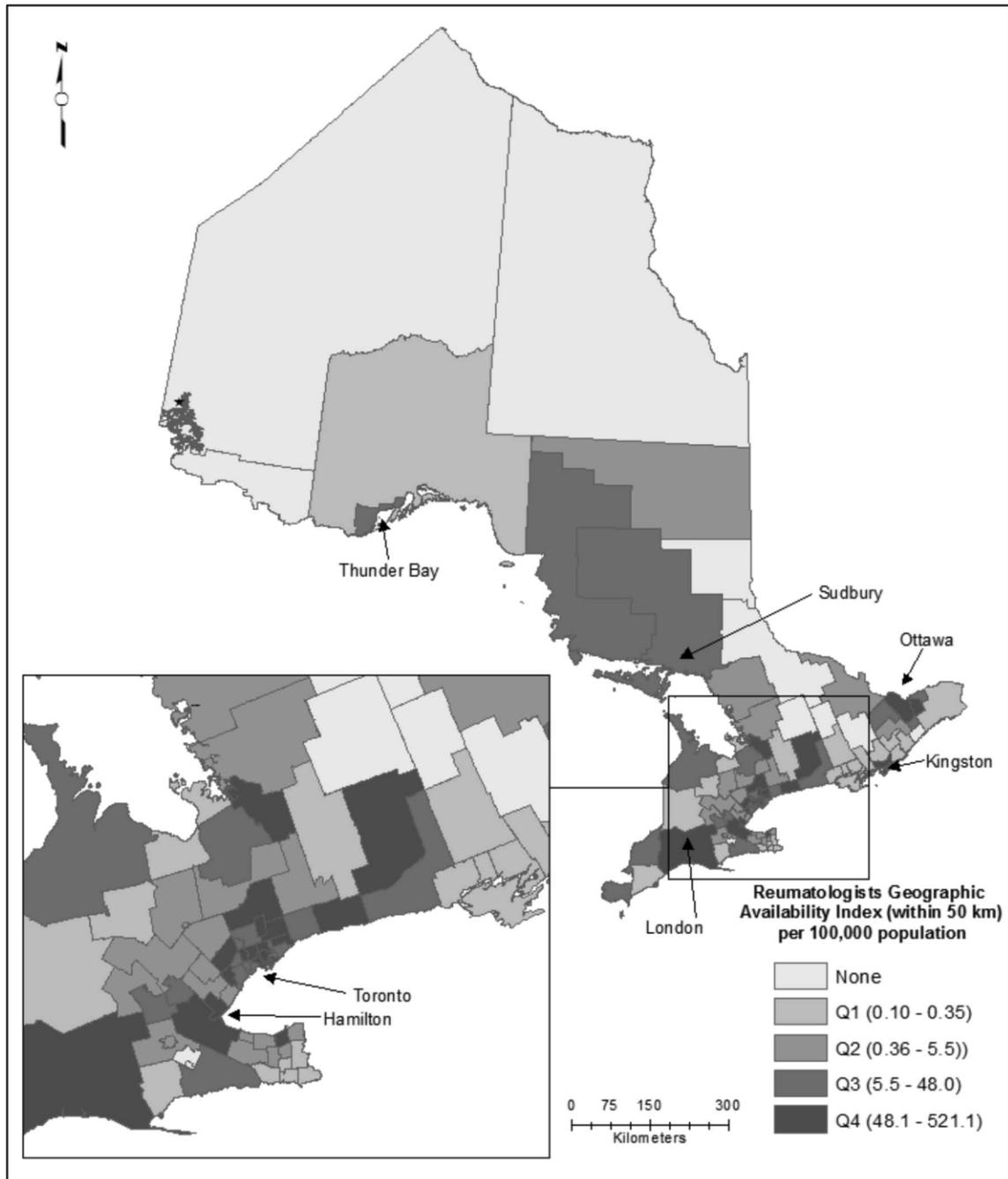
	Median	Min.–max.
Visits for all arthritis†		
To rheumatologists	13.4	5.3–26.0
To all physicians‡	130.4	60.7–218.5
Visits for all inflammatory arthritis†		
To rheumatologists	6.9	1.8–14.8
To all physicians	11.5	3.3–30.6
Access to PCPs‡		
Patients with visits for musculoskeletal disorders	250.4	140.3–558.7
Availability of rheumatologists		
Rheumatologists availability index (weighted hours per week per 100,000 population)	3.1	0.0–521.1
Distance to nearest rheumatologist location, km	44.7	1.0–584.0
Percent population within 50 km of rheumatologists	75.0	0.0–100.0

\* Min. = minimum; max. = maximum.  
 † Rates per 1,000 population.  
 ‡ Includes rheumatologist, PCPs, and other types of physicians.

of the squared distance gives more weight to nearer locations, so the farther away the rheumatologist, the lower the contribution to the overall availability for the population. The contributions for each rheumatologist location were combined and the index was expressed as the weighted sum per 100,000 population. In a final step, a weighted index for each health planning area was calculated by aggregation of the respective DA-level data to the relevant health planning area. All spatial calculations were performed using ArcGIS 9.1 and SAS. Given the distribution of the geographic availability index, for analytic purposes, a 5-level variable was created with a category for zero availability, and then quartiles for the remaining health planning areas.

This study received ethical approval through the Institutional Research Board of Sunnybrook Health Sciences Centre to access the health care utilization databases. Research ethics approval from the University Health Network was obtained for conducting the survey of rheumatologists.

**Statistical analysis.** Multilevel Poisson regression was used to examine factors associated with the rates of rheumatology visits for all arthritis and for inflammatory arthritis. The outcomes were modeled as age and sex strata nested within each health planning area to account for variation in rates at the individual level. Based on previous work, an age by sex interaction term was added to all models to correct for the differential pattern in rates of office visits across sex and age groups (21). Random intercept models were used to allow the outcomes to vary across health planning areas and the Poisson distribution was used. Population counts for each stratum were added



**Figure 2.** Index of geographic availability of rheumatologists across health planning areas, Ontario, fiscal year 2007–2008. Cities with medical schools are identified in the map: Thunder Bay, Sudbury (Northern Ontario School of Medicine: opened in 2005, so was still in start-up mode at the time of the 2007 rheumatologist survey); Ottawa (University of Ottawa Medical School); Kingston (School of Medicine Queen’s University); Toronto (University of Toronto Medical School); Hamilton (Michael G. DeGroot School of Medicine, McMaster University); London (Schulich School of Medicine & Dentistry, University of Western Ontario).

as an offset in all models. The estimates obtained from the regression models compare the log of the rate of office visits by individual and area-level indicators: rheumatologist geographic availability, PCP access, SES, age of the population, and proportion of rural population. Rate ratios were calculated by exponentiating the regression coefficients. We used a sequential approach to perform the analyses. All models included individuals’ age and sex, an

age–sex interaction term, and area-level indicators. We modeled office visit rates to rheumatologists for all arthritis and for inflammatory arthritis separately, testing for main effects as well as adjusted models. Analyses were conducted in SAS using proc GLIMMIX. Rate ratios for the fixed effects (i.e., individual- and area-level indicators) and 95% confidence intervals from multilevel regression models are presented.

**Table 2. Rate per 1,000 population for visits to all physicians and rheumatologists for all arthritis and inflammatory arthritis by individual and area-level indicators; Ontario, fiscal year 2007–2008\***

	All physician†		Rheumatologists	
	All arthritis	Inflammatory arthritis	All arthritis	Inflammatory arthritis
Individual-level indicators				
Sex				
Women	150.2	16.1	20.0	9.8
Men	114.2	7.2	8.1	3.6
Age groups, years				
18–24	41.1	2.4	2.2	1.4
25–34	59.4	4.3	4.2	2.6
35–44	93.5	7.3	8.0	4.3
45–54	151.1	12.7	15.6	7.5
55–64	201.5	19.6	25.0	11.6
65–74	238.7	24.3	30.8	14.2
≥75	246.0	23.2	29.1	11.8
Area-level indicators				
Geographic availability of rheumatologists				
None	131.2	11.2	15.0	6.8
Quartile I	133.2	11.6	14.4	6.3
Quartile II	134.3	13.0	15.1	8.3
Quartile III	136.3	12.5	11.3	6.8
Quartile IV (highest)	129.6	12.7	9.8	6.5
Access to PCP				
Quintile I (lowest)	112.7	10.6	10.2	5.6
Quintile II	122.2	11.7	11.6	6.2
Quintile III	129.4	12.0	14.0	6.9
Quintile IV	139.2	12.8	15.5	7.8
Quintile V (highest)	141.1	11.2	15.9	6.6
SES				
Quintile I (lowest)	127.6	12.1	11.1	5.8
Quintile II	137.8	12.6	12.4	6.3
Quintile III	134.4	11.6	13.0	6.6
Quintile IV	132.3	11.7	14.8	6.9
Quintile V (highest)	130.2	11.2	17.1	7.5
Proportion of population age ≥65 years				
Quintile I (lowest)	128.5	11.3	15.4	6.9
Quintile II	131.6	11.1	15.4	7.1
Quintile III	132.3	11.8	13.2	6.4
Quintile IV	137.0	13.4	13.4	6.8
Quintile V (highest)	139.9	12.0	13.1	6.7
Proportion of rural population				
<15%	132.6	11.2	15.5	6.7
15–50%	131.5	12.8	12.1	6.8
>50%	135.3	12.6	12.0	7.2

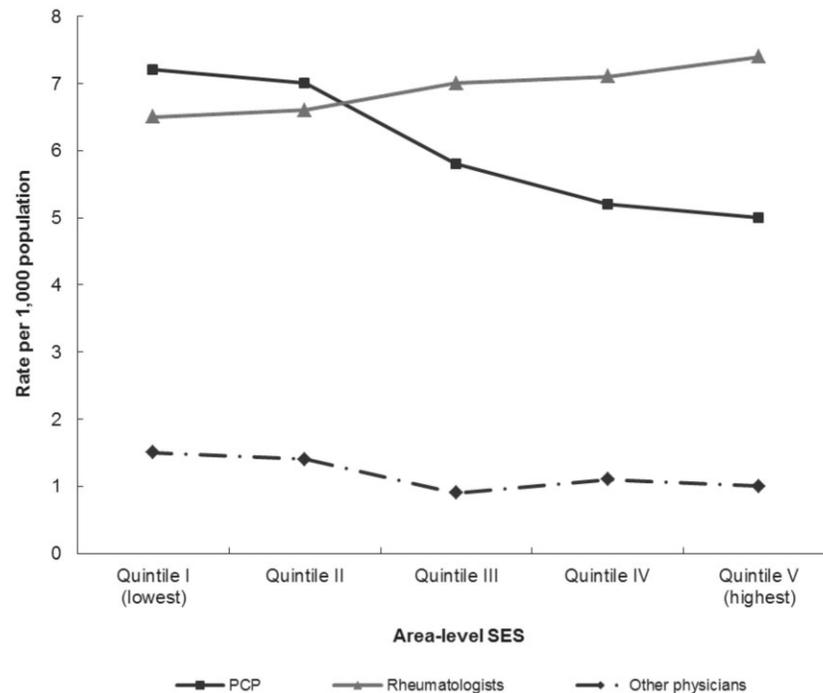
\* PCP = primary care physician; SES = socioeconomic status.  
† Includes rheumatologists, primary care physicians, and other types of physician.

**Sensitivity analysis.** Results are presented for the index of geographic availability of rheumatologists calculated using a distance of 50 km. An index calculated using 25-km, 75-km, and 100-km thresholds yielded similar results.

## RESULTS

In Ontario in the 2007–2008 fiscal year, the rate of visits to all physicians for any kind of arthritis was 130.4 per 1,000 population and the rate of visits to rheumatologists was 13.4 per 1,000 population. This represents 10.3% of all

patients who made at least 1 visit to a physician for any kind of arthritis. There was a wide variation (from 5.3 to 26.0 per 1,000 population) across health planning areas for visits to rheumatologists. Analogous rates for the subset of patients with inflammatory arthritis were 11.5 per 1,000 population with visits to all physicians and 6.9 per 1,000 population (68,000 patients) with visits to a rheumatologist, with a 7-fold variation by health planning area (from 1.8 to 14.8 per 1,000 population) (Table 1). Visits to rheumatologists for inflammatory arthritis represented 60.0% of visits to all physicians for these conditions. The median number of visits to PCPs for musculoskeletal disorders,



**Figure 3.** Rate of visits to rheumatologists, primary care physicians (PCPs), and other physicians for inflammatory arthritis, by quintiles of area socioeconomic status (SES), Ontario: fiscal year 2007–2008.

our indicator of PCP access, was 250.4 per 1,000, with a 4-fold variation across health planning areas. The median geographic availability index of rheumatologists was highly skewed: 11 of the 105 health planning areas had no availability, and the availability index in the remaining areas ranged up to 521.1 per 1,000,000 population. Figure 2 shows that the highest availability was in the southern part of the province and in the cities with medical schools. The median distance to a rheumatologist was 44.7 km, up to a maximum of 584 km. Nevertheless, 75% of the population lived within 50 km of the nearest rheumatologist.

Table 2 shows the rates of visits per 1,000 population to all physicians and to rheumatologists for all arthritis and for inflammatory arthritis. The rates for all arthritis and for inflammatory arthritis were higher for women than men and increased with increasing age until the age 65–74 years group. The data for the area-level indicators illustrate the variability in visits rates. In addition, Figure 3 shows the rates of visits for inflammatory arthritis by physician type. The results suggest that the rate of visits to rheumatologists was highest in areas in the highest quintile of SES, with the opposite trend for PCP access, where more patients in the lowest quintile areas were seen by PCPs rather than rheumatologists. Only a small proportion of patients saw other types of physicians.

Table 3 displays the results of the Poisson regressions for the office visits to rheumatologists for all arthritis and inflammatory arthritis. After adjustments for age and an age–sex interaction, there was a positive association between the geographic availability of rheumatologists with visit rates for all arthritis, which was reduced after controlling for access to PCPs and SES. There was no association between geographic availability of rheumatologists

and visits for inflammatory arthritis. Access to PCPs and area-level SES were significantly associated with the visit rates for all arthritis and inflammatory arthritis. There were no significant associations with the proportion of the population age >65 years or the proportion of rural population.

## DISCUSSION

This multilevel study examining the geographic variation of patterns of care for arthritis across health planning areas in Ontario, Canada showed no relationship between an index of availability of rheumatologists with visits to rheumatologists for inflammatory arthritis, and only a small effect for visits for all arthritis. However, the findings do suggest that living in areas with low access to PCPs and low SES is associated with a lower likelihood of having a rheumatologist visit for both all arthritis and inflammatory arthritis. This may imply difficulty accessing timely and appropriate referral and treatment. It is also of concern as the expectation is that the prevalence of arthritis should be higher in areas of low SES (18).

The index of geographic availability of rheumatologists used in this study is novel. It combines the amount of service available with the distance between rheumatologists and population locations, under the assumption that the closer the medical services, the easier it is to access them. This measure is an improvement over traditional physician:population ratios since it incorporates travel distances. The use of office hours per week of service provision is more accurate than full-time equivalents, as it excludes time spent in teaching, administration, and re-

**Table 3. Multilevel Poisson regression models for the rate of office visits to rheumatologists for inflammatory arthritis and all arthritis: rate ratios (RRs) and 95% confidence intervals (95% CIs) for the main and adjusted effects of geographic availability of rheumatologists, access to PCP, and SES; Ontario, fiscal year 2007–08\***

	RR (95% CI) for arthritis office visits		RR (95% CI) for inflammatory arthritis office visits	
	Main effect models	Adjusted model, model 2	Main effect models	Adjusted model, model 2
Geographic availability of rheumatologists				
None	1.00	1.00	1.00	1.00
Quartile I	1.08 (0.90–1.28)	0.98 (0.84–1.14)	0.96 (0.80–1.14)	0.91 (0.77–1.08)
Quartile II	1.40 (1.17–1.67)†	1.10 (0.98–1.37)	1.16 (0.97–1.40)	1.09 (0.91–1.32)
Quartile III	1.14 (1.01–1.39)†	1.02 (0.86–1.23)	0.88 (0.72–1.08)	0.87 (0.71–1.06)
Quartile IV (highest)	1.30 (1.05–1.61)†	1.17 (1.01–1.41)†	1.06 (0.86–1.32)	1.05 (0.85–1.29)
Access to PCP				
Quintile I (lowest)	1.00	1.00	1.00	1.00
Quintile II	1.06 (0.90–1.25)	1.06 (0.91–1.22)	1.03 (0.87–1.21)	1.06 (0.90–1.24)
Quintile III	1.22 (1.02–1.45)†	1.10 (0.94–1.29)	1.11 (0.93–1.32)	1.03 (0.87–1.23)
Quintile IV	1.31 (1.11–1.56)†	1.30 (1.12–1.52)†	1.33 (1.12–1.58)†	1.28 (1.08–1.52)†
Quintile V (highest)	1.53 (1.27–1.85)†	1.41 (1.20–1.66)†	1.27 (1.05–1.53)†	1.21 (1.01–1.46)†
SES				
Quintile I (lowest)	1.00	1.00	1.00	1.00
Quintile II	1.08 (0.91–1.28)	1.06 (0.90–1.24)	1.01 (0.84–1.21)	1.03 (0.87–1.23)
Quintile III	1.20 (1.01–1.42)†	1.16 (1.00–1.36)†	1.11 (0.93–1.33)	1.14 (0.96–1.35)
Quintile IV	1.31 (1.09–1.57)†	1.32 (1.12–1.57)†	1.21 (1.00–1.46)†	1.30 (1.08–1.57)†
Quintile V (highest)	1.47 (1.22–1.76)†	1.40 (1.19–1.65)†	1.30 (1.07–1.57)†	1.30 (1.08–1.56)†

\* All models include age, sex, age and sex interaction, percent population age ≥65 years, and percentage of rural population. PCP = primary care physician; SES = socioeconomic status.  
† Significant at  $P < 0.05$ .

search. The index also smooths the distribution of rheumatologist availability, and gives a more realistic measure of coverage, particularly for areas with no rheumatologists that are adjacent to areas of more abundant provision.

We found a large area variation in geographic availability of rheumatologists, with a clustering of provision in more populated areas, which is similar to a recent paper on the distribution of rheumatologists in the US (28). This American paper suggested that patients with arthritis living in areas with no or few practicing rheumatologists are likely to have limited access to care. Our findings showed that availability of rheumatology services may not be the only barrier in accessing appropriate care, particularly for inflammatory arthritis. In our study, the visit rates for arthritis were associated mainly with area-level SES and access to PCPs. It could be that rheumatologists tend to be in areas with higher SES and to be co-distributed with PCPs. However, this would not fully account for our findings, as in our main effect models the availability of rheumatologists was not associated with the rate of visits for inflammatory arthritis, although there was a moderate relationship for all arthritis.

Our findings may also be instructive for attempts to determine the need for rheumatologist services. Studies to calculate the need for rheumatologists in the US have assumed that the need is proportionate to the age and sex distribution of conditions likely to be managed by rheumatologists, taking into account the demographics of the current workforce (11). In addition, our study suggests that the socioeconomic situation of local areas needs to be

taken into account when estimating rheumatologists' needs. Furthermore, in places where specialists are only seen by referral from another physician, a situation that is also becoming increasingly frequent in the US, the availability of referring physicians may also need to be taken into account.

On first sight it seems to be a positive finding that the index of geographic availability of rheumatologists was associated with visits for all arthritis. However, this raises questions about where patients with arthritis, other than inflammatory arthritis, can turn to for specialist care in areas where rheumatologists are not available. That there was no association of rheumatologists' availability with visits for inflammatory arthritis concurs with the findings of a study from Quebec, Canada (17). The findings suggest that, once referred, rheumatologists give preference to inflammatory arthritis patients, i.e., patients with other forms of arthritis are likely to be seen only in those areas where there is adequate availability of rheumatologists. This fits with studies of wait times that have confirmed that rheumatologists tend to prioritize inflammatory arthritis patients (29,30). The lack of association between rheumatologist availability and visits for inflammatory arthritis may also be a sign that there is a systemic under-provision in all areas.

The finding that less than two-thirds of all inflammatory arthritis visits were to rheumatologists is similar to that from other population-based studies (6,7). The proportion varied somewhat by area characteristics: the highest proportion visiting a rheumatologist was 67% in areas of high

SES. As shown in Figure 3, patients with visits for inflammatory arthritis and not seeing a rheumatologist were likely to see PCPs, particularly in low SES areas. This is concerning, since patients without ready access to rheumatology tend to have worse outcomes (31) and, as indicated in the Introduction, inflammatory arthritis patients treated by PCPs are less likely to be treated with DMARDs (4–7).

The few studies that have examined the effect of SES on access to rheumatologists in the population are consistent in suggesting access barriers for low SES individuals. A population-based study using administrative data showed longer delays in consultation with a rheumatologist for those living in low versus higher SES areas (32), and a clinical study of RA patients found that those with low SES made significantly less use of specialist care (33). Furthermore, studies of patients with systemic lupus erythematosus have found that patients with low SES were less likely to visit rheumatologists (34,35). The literature is also consistent in showing that low SES patients with inflammatory arthritis have worse outcomes than those with higher SES (36–38). These inequalities by SES may be a reflection of higher demand by high SES patients or may indicate barriers to access to care, including travel distances, costs, loss of wages (39), and low health literacy (40).

The inverse association between visit rates to rheumatologists for inflammatory arthritis and access to PCPs suggests that patients who do not have access to PCPs are less likely to be referred. While this seems to be common sense, it does suggest a need for other arrangements to identify and refer patients. Strategies to encourage early referral for inflammatory arthritis have largely focused on triage of referrals and on the need for education of PCPs (3). These approaches may need to be broadened to develop strategies to reach potential patients who may not have easy access to PCPs for assessment and referral. These tend to be in more rural areas that may not be able to support a full-time rheumatologist. In Ontario, some rheumatologists travel to rural locations on an occasional basis and the use of telemedicine is increasing.

A further solution is the use of other practitioners. Primary health care reform in Ontario is promoting interprofessional health care teams and nurse practitioners providing care, particularly in areas of doctor shortages (41). This needs to be supported by arthritis-related interprofessional education (42). In Ontario, the Advanced Clinician Practitioner in Arthritis Care program is a training program for experienced physical therapists, occupational therapists, and nurses to assume roles of triage, education, and, in selected cases, management of patients with osteoarthritis and inflammatory arthritis (43). Evaluation of this program has shown reduced wait times and indicated potential to provide access to arthritis care in areas where there are severe shortages of specialized arthritis care physicians (43). Although an encouraging finding, sustainable funding will continue to be a potential barrier for the wider implementation of such programs.

A major advantage of our study is the comprehensive coverage of the Ontario publicly funded health care system, which covers all medically necessary physician vis-

its, without the impacts of insurance coverage on access to care seen in the US. This permitted us to look at the influence of ecological variables, such as per capita provision of rheumatology and PCP services on rheumatology visits. Furthermore, we were also able to examine the source of inequities in rheumatologist visit rates by further incorporating an area-based measure of SES. Our measure of availability of rheumatologists has the advantage of incorporating the number of hours of clinical service provided per week. However, we had no information about whether rheumatologists were accepting new patients or not, nor do we know anything about quality of care. The lack of association with rheumatologist availability does not rule out the fact that patients living in areas of low availability could be referred to other areas. Indeed, many of the areas of low availability are in the northern, sparsely populated part of Ontario where there are government-provided travel grants that fund patients to travel to receive services elsewhere.

Our study's limitations are those inherent to ecological studies and the use of health service data, including lack of individual data on variables associated with need for health care such as SES. We also have no information on patients in need of care who did not visit any physicians for their arthritis. The focus on variation between health planning regions may obscure large variations for individuals living within those regions. The definition of inflammatory arthritis was at least 1 visit to a physician; there is likely to be some diagnostic uncertainty and, in particular, inflammatory arthritis may be incorrectly classified by PCPs. Nevertheless, the overall prevalence for inflammatory arthritis, likely mainly rheumatoid arthritis, based on 1 visit, is 11.5 per 1,000 (Table 1), which is similar to a conservative population prevalence of approximately 1%, with the expected female preponderance and age profile (44). A further limitation is that we did not have the number of practicing PCPs and had to rely on a measure of utilization as a proxy for access. Differences in utilization rates may reflect not only variation in the number of available physicians but differences in the ability and preferences of physicians in managing common musculoskeletal disorders (5).

This is one of the few studies that examine variations in visits to rheumatologist services at the population level. Using area-based data on rheumatologist services for arthritis, this study provides some insights into the complexity of factors that impact how patients access rheumatology care. This study shows that patients with inflammatory arthritis living in areas of low SES or with a low provision of primary care services were less likely to see a rheumatologist. Models of care that incorporate primary health care resources, as well as the location and amount of rheumatology services, are crucial to improve access to care for people with all types of arthritis, particularly in areas of low SES. Nonetheless, our results point to the importance of considering factors related to access to PCPs to ensure adequate access to rheumatology services in the population, especially when access to specialty care requires primary care referral.

## AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Badley had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study conception and design.** Badley, Canizares, Gunz, Davis.

**Acquisition of data.** Badley, Canizares, Davis.

**Analysis and interpretation of data.** Badley, Canizares, Gunz, Davis.

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