Does Socioeconomic Status Affect Outcomes in Early Inflammatory Arthritis? Data from a Canadian Multisite Suspected Rheumatoid Arthritis Inception Cohort

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ABSTRACT. ***Objective.*** To assess the effect of socioeconomic status (SES) on outcomes in patients with early inflammatory arthritis, using data from the Canadian Early Arthritis Cohort (CATCH) study.

Methods. In an incident cohort, 2023 patients were recruited, and allocated to low SES or high SES groups based on education and income. Outcomes at baseline and 12 months were analyzed in relation to SES including the 28-joint Disease Activity Score (DAS28), Simplified Disease Activity Index (SDAI), pain, patient's global assessment scale (PtGA), the Health Assessment Questionnaire–Disability Index (HAQ-DI), and the SF12-v2 Health Survey, using the ANOVA, chi-squared test, and regression analyses.

Results. The CATCH population had 43% with high school education or less and 37% in the low-income group (< 50,000 Can$ per annum household income). The low-education group had higher DAS28 at baseline (p = 0.045), becoming nonsignificant at 12 months and lower physical component score on SF12-v2 at baseline (p = 0.022). Patients in the low-income group presented with higher HAQ-DI (p = 0.017), pain (p = 0.035), PtGA (p = 0.004), and SDAI (p = 0.022). Low-income versus high-income groups were associated with an OR above the median for HAQ-DI (1.20; 95% CI 1.00–1.45), PtGA (1.27; 95% CI 1.06–1.53), and SDAI (1.25; 95% CI 1.02–1.52) at baseline. The association with low income persisted at 12 months for HAQ-DI (OR 1.30; 95% CI 1.02–1.67), but not for other variables.

Conclusion. Low SES was initially associated with higher disease activity, pain, and PtGA, and poorer function. At 1 year, outcomes were similar to those with high SES, with the exception of HAQ-DI. (J Rheumatol First Release Nov 15 2014; doi:10.3899/jrheum.131382)

Key Indexing Terms:

EARLY RHEUMATOID ARTHRITIS	INCIDENT COHORT	REMISSION
SOCIOECONOMIC STATUS	INCOME	EDUCATION

Lower socioeconomic status (SES) has been known to be associated with increased mortality, worse disease activity, poorer function, and more pain and disability in patients with rheumatoid arthritis (RA)[1,2,3,4,5,6,7,8,9]. SES has been defined in previous studies by neighborhood social deprivation and personal attributes such as education or occupation[1,2,3,4,5,6,7,8,9]. Whether at the community level or personal level, patients with low SES have been shown to have higher disease activity and lower quality of life at baseline[1,2,3,4,5,6,7,8,9]. Interestingly, several studies have

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shown that those with lower SES improve significantly more in outcome variables upon followup, although the differential between low and high SES remains[2,4]. There have been many hypotheses regarding the mechanism through which SES affects disease outcome. Low SES has been shown to be associated with less use of allied health resources and higher incidence of depression[3]. Learned helplessness is a concept that has been explored in a previous study, and found to be a potential mechanism by which SES associates with disease outcome[8]. The significance of SES on early RA disease outcome in the Canadian health system is still unclear because it has never been studied in a Canadian cohort. We evaluated the effect of SES on disease outcomes in patients with early RA or suspected RA defined as fixed joint symptom onset of less than 1 year.

MATERIALS AND METHODS

Patients. As of October 2012, there were 2023 patients enrolled in the Canadian Early Arthritis Cohort (CATCH) study. The CATCH study is a prospective cohort study of patients with early inflammatory arthritis (EIA) recruited at 17 sites across Canada since July 2007, with the objective of gathering longitudinal Canadian data to study treatment effectiveness. The inclusion criteria for CATCH have been published[10]: age > 16 years at time of enrollment, persistent synovitis for at least 6 weeks but less than 12 months, ≥ 2 swollen joints or 1 swollen metacarpophalangeal/proximal interphalangeal joint, and ≥ 1 of positive rheumatoid factor (RF), positive anticyclic citrullinated peptide (anti-CCP), morning stiffness > 45 min, response to nonsteroidal antiinflammatory drugs, or painful metatarsophalangeal squeeze test. Patients enrolled were evaluated at baseline and at followup visits every 3 months in the first year and every 6 months in the second year and annually thereafter, according to a standard protocol. Treatment options at any visit included monotherapy with methotrexate or another disease-modifying antirheumatic drug (DMARD), combination DMARD, biologics, and oral/intramuscular/intraarticular glucocorticoids. Treatment plans were left to the discretion of the treating physician; therefore, data pertaining to medications prescribed were not collected. Outcome measurements that were evaluated in the CATCH cohort at baseline, 3 months, 6 months, 9 months, and 12 months included the 28-joint disease activity score (DAS28), the pain visual analog scale (pain VAS), physician's global assessment (PGA), patient's global assessment (PtGA), Health Assessment Questionnaire–Disability Index (HAQ-DI)[11], Simplified Disease Activity Index (SDAI), Clinical Disease Activity Index (CDAI), and the SF-12v2 Health Survey[12].

Statistical analyses. SES was defined by either educational level or income. Educational level was categorized as low education (high school diploma and lower) and high education (postsecondary education and higher). Annual income, which was not specified on the questionnaires given to patients as household or individual income, was categorized as low income [≤ 50,000 (all dollars Canadian) below the median income] or high income (greater than $50,000). The median total family income for all family types in 2011 as provided by Statistics Canada is $50,610; therefore, the definition of low income in this study approximates below-median annual household income for an average Canadian family in 2011. The associations between SES and categorical variables such as ethnicity, employment status, education level, income level, smoking status, and marital status were studied using Pearson's chi-squared analyses. Employment status was defined as employed (including full-time, part-time, or seasonal employment), retired, homemaker, student, disabled, on sick leave, on maternity leave, or unemployed. Smoking status was defined as current smoker, ex-smoker, or never smoker; a patient is considered a smoker in our analyses if he or she currently smokes. Marital status is defined as single, common law, or married.

Continuous variables were analyzed using 1-way ANOVA analyses. The associations between SES and outcomes were quantified using binary logistic and multiple linear regression models. The model analyzed OR for low SES and above versus below median disease activity and disability. The OR were adjusted for age, sex, symptom duration, meeting the American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) criteria for RA[13], and smoking status, which were confounders known to influence disease activity in patients with RA. Available case analysis was performed instead of complete case analysis. Cases were not excluded because of some missing data; instead, all cases were analyzed if the variable of interest was present. Missing variables were excluded from analyses (i.e., a complete case analysis for the variables of interest was used). A subgroup analysis was performed for patients who satisfied the ACR 2010 criteria for RA[13]. Outcome and disease activity measures such as DAS28-erythrocyte sedimentation rate (ESR), HAQ-DI, pain, ESR, PtGA, SDAI, CDAI, and SF-12 were analyzed using ANOVA.

RESULTS

Cohort characteristics. A total of 2023 patients were enrolled in CATCH. Of those, 1991 patients self-reported an education level, and 1990 self-reported an income level. There were 357 without data at 12 months for various reasons (96 withdrew consent, 113 were lost to followup, 90 did not have RA, 15 had comorbidity, for 32 the physician had moved, 7 patients died, 4 had a language issue). The remainder of the patients (111) had not yet had the 12-month visit. Differences in withdrawal rates between income and education groups studied were not significant. The mean age of the cohort was 53; 73% were women, 82% were white, 71% were either married or had a common law partner, 54% were employed (includes full-time, part-time, and seasonal employment), 38% had less than $50,000 annual income, and 19% were current smokers. Mean symptom duration at presentation was 184 days, 78% met 2010 ACR/EULAR criteria for RA, 58% had positive RF, and 51% had positive anti-CCP. Cohort baseline characteristics are shown in Table 1.

SES as defined by education: comparison of baseline characteristics and outcomes between education cohorts. Forty-three percent of the cohort was allocated to the low-education group, and 55% was allocated to the high-education group. The low-education group was significantly older, had fewer women, had a higher proportion of whites, a lower employment rate, lower income, shorter symptom duration, and a higher proportion of smokers (Table 1). The 2 groups did not differ significantly in RF positivity, anti-CCP positivity, or the percentage meeting the ACR/EULAR criteria. The low-education cohort had significantly higher mean DAS28 and ESR at baseline compared to the high-education group, but not at 12 months. The physical component score (PCS) of SF-12 was worse in the low-education group. These were not statistically different between cohorts at baseline: HAQ, pain VAS, PtGA, SDAI, and CDAI. At 12 months, however, PtGA and CDAI had worse values in the low-education group.

The binary logistic regression analysis showed that low

Table 1. Cohort characteristics by education level and income.

	Total	Low Education	High Education	p	Low Income	High Income	p
N (% of total)	2023	869 (43)	1122 (55.5)		747 (37)	1243 (61.4)	
Age, mean ± SD (n)	52.86 ± 15.49 (1990)	57.51 ± 14.72 (869)	49.25 ± 15.12 (1122)	**< 0.001**	52.97 ± 16.28 (746)	52.77 ± 15.00 (1243)	0.791
Meets 2010 ACR/EULAR criteria, % (n)	77.6 (1544)	79.6 (692)	76.1 (852)	0.059	80.8 (603)	75.8 (941)	**0.009**
Symptom duration, mean days ± SD (n)	184.24 ± 117.85 (1984)	178.0 ± 92.5 (868)	189.1 ± 134.2 (1116)	**0.03**	187.96 ± 107.48 (746)	181.94 ± 123.70 (1237)	0.270
Female, % (n)	73.0 (1453)	67.3 (585)	77.4 (868)	**< 0.001**	75.0 (560)	71.8 (893)	0.128
Rheumatoid factor+, % (n)	57.6 (1013)	56.8 (442)	58.1 (571)	0.574	60.5 (398)	55.8 (615)	0.055
Anti-CCP+, % (n)	50.6 (672)	49.6 (288)	51.4 (384)	0.507	47.4 (227)	52.4 (444)	0.082
Smoking status, % (n)				**< 0.001**			**< 0.001**
Smoker	18.9 (375)	23.1 (199)	15.7 (176)		23.3 (174)	16.3 (201)	
Ex-smoker	37.1 (735)	46.7 (351)	34.3 (384)		36.3 (271)	37.5 (463)	
Never	44.0 (873)	36.3 (313)	50.0 (560)		40.3 (301)	46.3 (572)	
Ethnicity							
White, % (n)	82.2 (1636)	82.6 (718)	81.8 (918)	**< 0.001**	75.1 (561)	86.4 (1074)	**< 0.001**
Marital status, % (n)				**< 0.001**			**< 0.001**
Single	14.1 (280)	10.0 (87)	17.2 (193)		20.3 (152)	10.3 (128)	
Common law	10.6 (211)	10.2 (89)	10.9 (122)		9.2 (69)	11.4 (142)	
Married	60.3 (1200)	60.5 (526)	60.1 (674)		50.5 (377)	66.2 (823)	
Employment, % (n)				**< 0.001**			**< 0.001**
Employed	54.2 (1080)	41.0 (356)	64.5 (724)		45.6 (341)	59.5 (739)	
Retired	25.8 (513)	35.6 (309)	18.2 (204)		29.2 (218)	23.7 (293)	
Homemaker	6.7 (134)	9.1 (79)	4.9 (55)		5.8 (43)	7.3 (91)	
Student	3.2 (63)	2.3 (20)	3.8 (43)		5.5 (41)	1.8 (22)	
Disabled	2.2 (43)	2.8 (24)	1.7 (19)		3.6 (27)	1.3 (16)	
Maternity	1.2 (23)	0.5 (4)	1.7 (19)		0.8 (6)	1.4 (17)	
Sick leave	3.3 (65)	4.5 (39)	2.3 (26)		3.6 (27)	3.1 (38)	
Unemployed	3.5 (70)	4.4 (38)	2.9 (32)		5.9 (44)	2.1 (26)	
Income, % (n), $Canadian				**< 0.001**			
None	2.9 (57)	3.0 (26)	2.8 (31)				
< $20,000	11.1 (220)	13.2 (115)	9.4 (105)				
$20,000–$50,000	23.6 (470)	26.8 (233)	21.1 (237)				
$50,000–$100,000	17.9 (356)	10.6 (92)	23.6 (264)				
> $100,000	9.1 (182)	2.9 (25)	14.0 (157)				
Did not wish to answer	35.4 (705)	43.5 (378)	29.2 (327)				
Education, % (n)							**< 0.001**
Elementary					10.2 (76)	8.0 (100)	
High school					39.9 (298)	31.8 (395)	
College					34.1 (255)	28.7 (357)	
University					9.6 (72)	22.4 (278)	
Masters					1.5 (11)	3.9 (48)	
PhD					0.3 (2)	1.1 (14)	
Other					4.4 (33)	4.1 (51)	
BMI, mean ± SD (n)	27.88 ± 6.01 (975)	28.04 ± 5.74 (392)	27.72 ± 6.18 (576)	0.426	27.54 ± 6.02 (397)	28.06 ± 6.00 (572)	0.185
DAS28-ESR, mean ± SD (n)							
Baseline	4.91 ± 1.50 (1780)	4.99 ± 1.46 (768)	4.85 ± 1.52 (1000)	**0.045**	4.92 ± 1.51 (665)	4.91 ± 1.49 (1102)	0.809
6 mos	3.23 ± 1.47 (1203)	3.33 ± 1.41 (511)	3.16 ± 1.51 (685)	**0.024**	3.25 ± 1.46 (444)	3.22 ± 1.47 (752)	0.759
12 mos	2.88 ± 1.42 (940)	2.90 ± 1.38 (399)	2.86 ± 1.45 (535)	0.428	2.94 ± 1.46 (375)	2.83 ± 1.39 (559)	0.321
HAQ score, mean ± SD (n)							
Baseline	0.982 ± 0.707 (1954)	0.974 ± 0.669 (841)	0.98 ± 0.73 (1084)	0.755	1.02 ± 0.69 (730)	0.95 ± 0.71 (1194)	**0.017**
6 mos	0.558 ± 0.595 (1291)	0.57 ± 0.58 (548)	0.549 ± 0.606 (732)	0.308	0.586 ± 0.617 (537)	0.516 ± 0.581 (885)	**0.033**
12 mos	0.495 ± 0.586 (1143)	0.524 ± 0.579 (494)	0.474 ± 0.588 (642)	0.100	0.545 ± 0.613 (433)	0.456 ± 0.555 (647)	**0.019**
Pain, mean ± SD (n)							
Baseline	5.49 ± 2.83 (1915)	5.57 ± 2.74 (819)	5.40 ± 2.90 (1067)	0.237	5.65 ± 2.85 (719)	5.37 ± 2.81 (1194)	**0.035**
6 mos	3.29 ± 2.74 (1263)	3.33 ± 2.65 (533)	3.27 ± 2.81 (719)	0.484	3.27 ± 2.77 (532)	3.25 ± 2.74 (863)	0.941
12 mos	2.87 ± 2.60 (1127)	2.95 ± 2.55 (487)	2.81 ± 2.64 (633)	0.191	3.02 ± 2.73 (424)	2.74 ± 2.54 (635)	0.130
ESR, mean ± SD (n)							
Baseline	26.78 ± 23.00 (1872)	27.77 ± 22.88 (809)	25.97 ± 23.09 (1048)	**0.019**	26.03 ± 22.60 (693)	27.18 ± 23.26 (1167)	0.212
6 mos	17.02 ± 15.58 (1157)	17.51 ± 15.44 (488)	16.62 ± 15.71 (663)	0.083	16.24 ± 14.83 (477)	17.13 ± 15.87 (789)	0.351
12 mos	15.86 ± 15.65 (1034)	16.01 ± 16.39 (440)	15.75 ± 15.13 (588)	0.847	14.95 ± 14.95 (392)	15.89 ± 16.01 (600)	0.421

Table 1. Continued.

	Total	Low Education	High Education	p	Low Income	High Income	p
PGA, mean ± SD (n)							
Baseline	4.64 ± 2.50 (1931)	4.66 ± 2.45 (829)	4.62 ± 2.54 (1072)	0.700	4.64 ± 2.49 (715)	4.64 ± 2.51 (1187)	0.943
6 mos	2.09 ± 2.11 (1276)	2.05 ± 2.06 (549)	2.11 ± 2.15 (716)	0.681	2.00 ± 2.04 (529)	2.03 ± 2.13 (879)	0.650
12 mos	1.58 ± 1.93 (1145)	1.60 ± 1.93 (499)	1.55 ± 1.92 (638)	0.709	1.52 ± 1.86 (426)	1.50 ± 2.01 (663)	0.209
PtGA, mean ± SD (n)							
Baseline	57.07 ± 29.73 (1949)	56.7 ± 29.18 (836)	56.92 ± 30.16 (1085)	0.850	59.41 ± 29.29 (728)	55.31 ± 29.90 (1192)	**0.004**
6 mos	34.67 ± 28.10 (1339)	36.07 ± 28.10 (580)	33.67 ± 28.14 (748)	0.133	34.54 ± 28.46 (539)	33.61 ± 27.71 (941)	0.662
12 mos	30.30 ± 27.17 (1174)	32.16 ± 27.26 (515)	28.82 ± 27.13 (651)	0.033	30.63 ± 27.50 (435)	29.10 ± 27.02 (687)	0.304
CDAI, mean ± SD (n)							
Baseline	77.46 ± 36.32 (1870)	77.70 ± 35.12 (802)	76.92 ± 37.20 (1042)	0.669	79.62 ± 35.72 (696)	75.85 ± 36.57 (1148)	0.027
6 mos	42.67 ± 33.53 (1230)	43.69 ± 33.26 (526)	41.94 ± 33.82 (693)	0.231	41.62 ± 33.38 (507)	41.04 ± 33.13 (847)	0.707
12 mos	35.98 ± 31.23 (1102)	37.65 ± 30.62 (478)	34.65 ± 31.77 (616)	0.049	36.72 ± 32.19 (414)	34.65 ± 31.23 (631)	0.264
SDAI, mean ± SD (n)							
Baseline	90.52 ± 44.24 (1716)	91.00 ± 43.19 (733)	89.66 ± 44.95 (959)	0.577	92.93 ± 43.29 (644)	88.63 ± 44.65 (1048)	**0.022**
6 mos	49.31 ± 36.44 (1021)	50.19 ± 36.37 (432)	48.53 ± 36.54 (580)	0.308	48.00 ± 35.14 (407)	47.17 ± 36.24 (703)	0.511
12 mos	40.98 ± 33.64 (938)	42.65 ± 32.75 (403)	39.63 ± 34.38 (530)	0.095	43.12 ± 35.46 (355)	39.24 ± 33.32 (539)	0.106
PCS, mean ± SD (n)							
Baseline	37.13 ± 10.54 (1725)	36.44 ± 10.21 (722)	37.63 ± 10.75 (1003)	**0.022**	36.88 ± 10.44 (698)	37.31 ± 10.61 (1026)	0.403
12 mos	45.00 ± 10.77 (796)	44.16 ± 10.69 (336)	45.61 ± 10.80 (460)	0.062	44.23 ± 11.19 (315)	45.50 ± 10.47 (481)	0.102
Withdrawals, n	468	204	264	0.892	199	268	0.266

Significant p values are bolded. ACR/EULAR: American College of Rheumatology/European League Against Rheumatism; anti-CCP: anticyclic citrullinated peptide; BMI: body mass index; DAS28-ESR: 28-joint Disease Activity Score–erythrocyte sedimentation rate; HAQ: Health Assessment Questionnaire; PGA: physician's global assessment; PtGA: patient's global assessment; CDAI: Clinical Disease Activity Index; SDAI: Simplified Disease Activity Index; PCS: physical component score of SF-12v2 Health Survey.

education was associated with above-median DAS28, but the OR was only significant at 6 months (OR 1.36, 95% CI 1.07–1.73; p = 0.01), and not at baseline or 12 months (Table 2).

SES as defined by income: comparison of baseline characteristics and outcomes between income cohorts. Thirty-seven percent of the cohort was allocated to the low-income group, and 61% to the high-income group. The low-income group had a significantly higher proportion of patients who were smokers, nonwhites, single, and unemployed; who met the ACR/EULAR criteria for RA; and who had less than post-high school education. The 2 groups were similar in age, sex, symptom duration, RF, and anti-CCP positivity (Table 1). With regards to disease outcomes, there was a significant difference observed in HAQ, pain VAS, PtGA, SDAI, and CDAI. The low-income group had a significantly higher HAQ at all timepoints (baseline, 6 mos, and 12 mos). Baseline pain, PtGA, CDAI, and SDAI were worse in the low income group (Table 1), and not statistically significant at 6 and 12 months.

Table 2. Binary logistic regression models.

	OR (95% CI)	p
OR for worse outcomes associated with low education		
Above median DAS28		
Baseline	1.14 (0.94–1.39)	0.19
6 mos	1.36 (1.07–1.73)	0.01
12 mos	1.04 (0.80–1.37)	0.76
OR for worse outcomes associated with low income		
Above median HAQ		
Baseline	1.20 (1.00–1.45)	0.05
12 mos	1.30 (1.02–1.67)	0.04
PtGA*, baseline	1.27 (1.06–1.53)	0.01
SDAI*, baseline	1.25 (1.02–1.52)	0.03

Each model adjusted for age, sex, symptom duration, smoking, and satisfying American College of Rheumatology 2010 criteria for rheumatoid arthritis. *12-month values were not significant. DAS28: 28-joint Disease Activity Score; HAQ: Health Assessment Questionnaire; PtGA: patient global assessment score; SDAI: Simplified Disease Activity Index.

The binary logistic regression analysis showed that low income was associated with above median HAQ at baseline (OR 1.20, 95% CI 1.00–1.45; p = 0.05) and at 12 months (OR 1.30, 95% CI 1.02–1.67; p = 0.04). In addition, low income was associated with above-median PtGA at baseline (OR 1.27, 95% CI 1.06–1.53; p = 0.01) and SDAI at baseline (OR 1.25, 95% CI 1.02–1.52; p = 0.03; Table 2).

Subgroup analysis of patients who satisfied the ACR 2010 criteria for RA at baseline. Characteristics and analyses of the subgroup of patients who satisfied the ACR 2010 criteria for RA are shown in Tables 3 and 4. Baseline DAS28-ESR was not significantly higher in patients with low education level (p = 0.09), whereas it was significantly higher (p = 0.045) in the original cohort. Baseline ESR was higher in patients with low education and was nearly statistically

Table 3. Subgroup analysis of patients satisfying ACR 2010 criteria for RA.

	Total	Low Education	High Education	p	Low Income	High Income	p
N (% of total)	1544	692 (45)	852 (55)		603 (39)	941 (61)	
DAS28-ESR, mean ± SD (n)							
Baseline	4.96 ± 1.50 (1389)	5.03 ± 1.48 (619)	4.89 ± 1.51 (770)	0.086	4.96 ± 1.50 (542)	4.95 ± 1.50 (847)	0.918
6 mos	3.21 ± 1.46 (956)	3.33 ± 1.41 (409)	3.12 ± 1.51 (547)	0.026	3.31 ± 1.48 (368)	3.15 ± 1.45 (588)	0.110
12 mos	2.89 ± 1.42 (760)	2.91 ± 1.38 (326)	2.87 ± 1.46 (434)	0.760	2.97 ± 1.48 (319)	2.83 ± 1.38 (441)	0.154
HAQ score, mean ± SD (n)							
Baseline	0.99 ± 0.71 (1495)	0.99 ± 0.68 (672)	0.98 ± 0.73 (823)	0.746	1.04 ± 0.68 (590)	0.95 ± 0.72 (905)	**0.010**
6 mos	0.54 ± 0.59 (1122)	0.55 ± 0.58 (489)	0.53 ± 0.61 (633)	0.623	0.59 ± 0.63 (442)	0.50 ± 0.57 (680)	**0.006**
12 mos	0.49 ± 0.58 (867)	0.52 ± 0.58 (380)	0.46 ± 0.57 (487)	0.122	0.54 ± 0.60 (365)	0.45 ± 0.55 (502)	**0.025**
Pain, mean ± SD (n)							
Baseline	5.50 ± 2.85 (1469)	5.62 ± 2.77 (655)	5.40 ± 2.91 (814)	0.134	5.70 ± 2.89 (583)	5.37 ± 2.82 (886)	**0.026**
6 mos	3.23 ± 2.74 (1099)	3.27 ± 2.66 (476)	3.20 ± 2.81 (623)	0.645	3.30 ± 2.80 (437)	3.19 ± 2.71 (662)	0.511
12 mos	2.80 ± 2.59 (850)	2.88 ± 2.51 (370)	2.74 ± 2.64 (480)	0.422	2.96 ± 2.71 (357)	2.69 ± 2.49 (493)	0.126
ESR, mean ± SD (n)							
Baseline	27.2 ± 23.0 (1447)	28.5 ± 23.4 (645)	26.2 ± 22.9 (802)	0.053	26.8 ± 22.9 (560)	27.5 ± 23.3 (887)	0.590
6 mos	16.8 ± 15.7 (1012)	17.0 ± 15.2 (437)	16.6 ± 16.1 (575)	0.687	16.6 ± 15.5 (398)	16.9 ± 15.9 (614)	0.757
12 mos	15.6 ± 15.7 (801)	15.6 ± 16.2 (344)	15.7 ± 15.3 (457)	0.934	15.0 ± 15.1 (331)	16.1 ± 16.0 (470)	0.337
PtGA, mean ± SD (n)							
Baseline	57.4 ± 29.8 (1496)	57.7 ± 29.5 (669)	57.2 ± 30.1 (827)	0.735	60.2 ± 29.3 (588)	55.6 ± 30.0 (908)	**0.003**
6 mos	33.7 ± 27.7 (1169)	34.7 ± 27.5 (519)	32.9 ± 27.9 (650)	0.278	35.0 ± 28.5 (445)	32.8 ± 27.2 (724)	0.196
12 mos	29.4 ± 27.2 (906)	31.1 ± 27.1 (405)	27.9 ± 27.2 (501)	0.077	30.5 ± 27.2 (367)	28.6 ± 26.6 (539)	0.308
CDAI, mean ± SD (n)							
Baseline	78.1 ± 36.6 (1448)	78.7 ± 35.8 (648)	77.6 ± 37.3 (800)	0.584	80.4 ± 35.9 (566)	76.7 ± 37.0 (882)	0.062
6 mos	40.9 ± 32.8 (1072)	41.8 ± 32.2 (469)	40.2 ± 33.2 (603)	0.428	42.4 ± 33.4 (417)	39.9 ± 32.3 (655)	0.230
12 mos	35.2 ± 31.5 (847)	36.8 ± 30.8 (375)	33.9 ± 32.0 (472)	0.176	36.9 ± 32.7 (349)	34.0 ± 30.6 (498)	0.190
SDAI, mean ± SD (n)							
Baseline	91.2 ± 44.7 (1334)	92.4 ± 44.2 (593)	90.3 ± 45.1 (741)	0.408	94.1 ± 43.4 (525)	89.3 ± 45.4 (809)	0.056
6 mos	46.5 ± 35.3 (883)	47.5 ± 34.6 (381)	45.7 ± 35.9 (502)	0.446	48.8 ± 35.9 (337)	45.0 ± 34.9 (546)	0.121
12 mos	40.8 ± 34.2 (727)	41.7 ± 32.9 (315)	40.1 ± 35.2 (412)	0.531	43.3 ± 35.7 (302)	39.0 ± 33.1 (425)	0.097
PCS, mean ± SD (n)							
Baseline	37.1 ± 10.6 (1337)	36.2 ± 10.2 (578)	37.8 ± 10.9 (759)	**0.007**	36.6 ± 10.5 (566)	37.5 ± 10.7 (771)	0.116
12 mos	45.1 ± 10.8 (652)	44.3 ± 10.5 (283)	45.7 ± 10.9 (369)	0.105	44.4 ± 11.0 (267)	45.6 ± 10.6 (385)	0.160

Significant P values are bolded. ACR: American College of Rheumatology; RA: rheumatoid arthritis; DAS28-ESR: 28-joint Disease Activity Score–erythrocyte sedimentation rate; HAQ: Health Assessment Questionnaire; PtGA: patient's global assessment; CDAI: Clinical Disease Activity Index; SDAI: Simplified Disease Activity Index; PCS: physical component score of SF-12v2 Health Survey.

significant (p = 0.053). Baseline PCS of the SF-12 showed similar significant findings compared to the original cohort. HAQ-DI at baseline, 6 months, and 12 months was worse in patients with low income, which is similar to findings in the original cohort. Baseline pain and PtGA scores were also worse in patients with low income. However, baseline SDAI and CDAI, both of which were significantly worse in patients with low income in the overall cohort, were numerically but not significantly worse in this subgroup (p = 0.056 and p = 0.062, respectively).

Table 5A shows the characteristics of those who completed 1 year of followup and of the 17% who dropped out. One-quarter of those who dropped out did not have RA (and by the protocol, they were removed from the study). Thus, it was expected that fewer in the dropout group would meet RA criteria, including having RF and anti-CCP positivity. Table 5B shows reasons for dropping out. There were some differences between those who remained in the study versus those who did not, including income but not education.

DISCUSSION

Our study showed that patients with EIA, including those meeting ACR criteria for RA and low SES, presented with higher disease activity, more pain, worse function, and more disability from disease. Interestingly, most of these relationships became statistically nonsignificant over time enrolled in the study. HAQ is the only outcome that remained significantly worse in patients with low SES at 12 months of followup. In the subgroup of patients who satisfied the ACR 2010 criteria for RA, there were fewer associations that were significant between SES and disease variables. For instance, only HAQ-DI at baseline and 6 and 12 months was worse in the low SES stratum, whereas only baseline pain, PtGA, and ESR were also higher in patients with low SES and PCS.

Low SES has been shown in previous studies to be associated with worse disease outcomes in patients with known RA and early RA[1,2,3,4,5,6,7,8,9]. Our study is the first, to our knowledge, to study the effect of SES on early RA in

Table 4A. Multivariate linear regression model: education level and DAS28-ESR.

	β Coefficient (95% CI)	p
DAS28-ESR		
Baseline	–0.138 (–0.280 to 0.003)	0.05
6 mos	–0.173 (–0.343 to –0.004)	0.05
12 mos	–0.020 (–0.207 to 0.166)	0.83

Table 4B. Multivariate linear regression model: income and associations with HAQ, PtGA, and SDAI.

	β Coefficient (95% CI)	p
HAQ		
Baseline	–0.072 (–0.137 to –0.006)	0.03
6 mos	–0.070 (–0.134 to –0.005)	0.03
12 mos	–0.082 (–0.153 to –0.010)	0.03
PtGA*, baseline	–4.143 (–6.893 to –1.393)	0.01
SDAI*, baseline	–3.726 (–7.159 to –0.294)	0.03

*12-mo values were not significant. DAS28-ESR: 28-joint Disease Activity Score–erythrocyte sedimentation rate; HAQ: Health Assessment Questionnaire; SDAI: Simplified Disease Activity Index; PtGA: patient's global assessment.

the Canadian healthcare system. Few studies have investigated this in an incident cohort or followed patients to assess SES effect on disease outcome over time. The advantages of studying the effect of SES on the early RA population are that the SES of these patients likely has not yet been affected by disability from their disease, and response to treatment early in their disease can be assessed in the context of SES differences. However, it is important to note that not all these patients met the ACR/EULAR 2010 criteria for the diagnosis of RA; 78% of patients enrolled met these criteria. Binary regression models yielded similar results in the stratum that met RA criteria.

In the few studies that followed patients with early RA, SES was associated with higher disease activity at baseline, but the results of SES on disease outcome upon followup were conflicting[2,5]. Our study showed that the negative effect of low SES at baseline resolved by 1 year with the exception of HAQ. The access to healthcare and affordability of traditional DMARD in the Canadian healthcare system may also explain why our study saw reversal of the negative SES effect on disease outcomes. There may be patient factors such as ethnicity that affect the self-reporting of HAQ. For example, Hispanic patients with RA were found to score significantly higher in self-reported HAQ compared to whites and African Americans, despite similarity in joint scores, ESR, and PGA[14]. There were too few ethnic minorities to explore this in our dataset. Low literacy could also affect HAQ scores[15]. Although our study does not explore some of these possible factors, poor coping

Table 5A. Characteristics of the 17% of patients who withdrew at 1 year versus patients who continued.

	Continued	Withdrew	p
Female, %	72.4	70.7	0.5
Meet RA 2010 criteria, %	80.1	63.7	< 0.0001
Income, %, $Canadian			0.022
None	4.0	7.2	
< $20,000	15.7	22.0	
$20,000–$50,000	36.4	34.5	
$50,000–$100,000	29.4	23.3	
> $100,000	14.5	13.0	
Education, %			0.8
Elementary school	8.2	9.6	
High school	34.9	32.4	
College/trade school	30.5	31.0	
University/bachelor	18.1	19.2	
Masters	3.2	3.7	
PhD	1.0	0.3	
Other	4.3	3.9	
Ethnicity, %			
White	83.3	76.6	0.07
Smoking status, %			< 0.0001
Never	43.1	51.4	
Current smoker	17.9	21.6	
Ex-smoker	39.0	27.0	
RF+	60.9	40.8	< 0.0001
Anti-CCP+, %	58.4	41.2	< 0.0001
Age, mean ± SD	53.4 ± 14.9	50.3 ± 17.7	0.0016
Disease duration, mean days ± SD	182.9 ± 109.6	189.8 ± 131.6	0.3
DAS28, mean ± SD	4.9 ± 1.5	4.8 ± 1.5	0.1
Tender joint count 28, mean ± SD	8.0 ± 6.5	8.3 ± 7.1	0.35
Swollen joint count 28, mean ± SD	7.2 ± 6.0	6.6 ± 6.3	0.057
ESR, mean ± SD	27.1 ± 22.7	25.2 ± 24.3	0.16
PtGA, mean ± SD	5.7 ± 3.0	5.7 ± 2.9	0.7

Table 5B. Reasons for dropping out of the ERA cohort.

Reason for Dropping Out	Percent
Not early RA diagnosis	25.2
Patient withdrew consent	26.8
Lost to followup	31.6
Moved	8.9
Patient died	2.1
Comorbidity	4.3
Poor English	1.1

RA: rheumatoid arthritis; RF: rheumatoid factor; anti-CCP: anticyclic citrullinated peptide; DAS28: 28-joint Disease Activity Score; ESR: erythrocyte sedimentation rate; PtGA: patient's global assessment; ERA: early RA.

mechanism and depression have been explored in previous studies as reasons to explain poorer outcomes in patients with low SES[7,8]. It is also possible that functional requirements to return to work are different between the low-income and high-income populations. For example, there may be a higher prevalence of employment requiring

manual labor within the low-income population. There may also be insurance differences in SES strata even in a publicly funded system, because medications are not universally covered. The public system may pay for certain medications only in the elderly or very poor populations, depending on each province. We did not study whether there were early medication differences because the DAS28 scores were not different between the groups, so it is unlikely that the lower SES group was undertreated. There could, however, be medication differences after the first year such as initiation of biologic medications (the rate in the first year of our cohort is very low but increases in the next couple of years).

Table 6 reviews the effects of SES on RA and early RA from the literature including worse effects on HAQ[1,2,3,4,5,6,8]. In our study, we used either education or income as 2 separate surrogates to define SES. The advantage of using education or income to define SES is that these factors are individualized, as opposed to a patient's residence in a particular neighborhood. Many studies that investigated SES effects on RA and EIA outcomes defined SES in terms of SES scores assigned to each patient's residence[1,5,6,8]. Social deprivation scores such as the Townsend Index of Disadvantage and Deprivation, the Carstairs Deprivation Score, and most recently, the Index of Multiple Deprivations take into account factors such as unemployment, not owning a car, not owning a home, household crowding, and social class to determine an overall deprivation score for each area across the United Kingdom. This makes the assumption that all persons residing within the same neighborhood are of the same SES. In our study, we had the advantage of access to patient self-reported income data, a statistic that carries significant weight in the determination of individual SES.

Ours is a study in early RA using 2 variables for SES in a large incident cohort, which helps us to understand the potential but weak effects of SES on disease.

Limitations of our study include nonstandardization of treatment, some missing data, variable length of followup, and using education and income as 2 separate surrogates to define SES instead of having a unified definition of SES. If we defined low SES as both lowest education and income strata, there were insufficient numbers to do analyses adjusting for confounders, because we had only about 200 patients who met those criteria. Also, low income cutoff was $22,000 to $25,000 annually, according to Statistics Canada, but if we used that cutoff, the numbers were too small. Using higher income biased our results toward a null effect, because the very lowest income group was not analyzed. The median income in Canada is $50,000 annually. The definition of poverty and low education may differ in various regions of Canada. Because this is an observational study of usual care, the treatment plan was left to the discretion of each treating rheumatologist and was not standardized. Also, coverage of medications is not universal across the nation and depends on different access in the provinces and various formularies. Available case analyses were performed, which explains the variations in sample size of different variables analyzed. Of the 2023 patients enrolled into this study at the time of analysis, there were 468 patients who had withdrawn or did not have 1 year of followup at the time of analysis. There were no between-group differences in withdrawal rates. We ensured that the variables studied had large sample population numbers to maintain power in our analyses, which made it impossible to combine education and income into 1 unified SES definition, because that would have meant losing power in our analyses. Also, the patient self-reported income did not differentiate between individual income and household income; therefore, this could have been biased by the lack of reporting spousal income. Finally, some differences in results such as the inconsistencies seen among low SES effects on CDAI, SDAI, and DAS28 can be due to the differences in components of composite scores that are used. For example, PGA and PtGA of disease activity are used in the CDAI and SDAI, whereas DAS28 uses the PtGA of health.

One American study showed that patients with RA and low income and other low SES factors were less likely to be prescribed DMARD[16].

There are not many adverse effects of SES on disease activity and function by 1 year in this early RA cohort (early RA and EIA). Perhaps the patients included demonstrate a "best case" scenario, in which patients are literate and willing to enter our observational cohort. The 17 sites included rheumatologists with an interest in early RA and an interest in collaborating with other sites. Thus there is a very positive bias for good outcomes in our study. It is reassuring that SES is not a major determinant of outcomes in ERA over the critical first year of disease, but the most marginalized patients would likely not have timely access to a rheumatologist and these patients could not be identified by our cohort. This can affect the generalizability of the data where patients not seen in these centers (or at all) may not have optimal outcomes.

The results of our study emphasize the importance of identifying patients with low SES to enable identification of a population likely to present with higher disease activity. What could be interesting is determining whether future differences are present in this early inflammatory cohort over the next few years, because there may be differential access to biologic DMARD and because the rate of biologics increases in our cohort over years 2 and 3. This is perhaps where outcomes between SES groups may vary if access to expensive medications is delayed or reduced in the low SES population.

Our study is the first, to our knowledge, to report the association of SES as measured by education and income with disease outcome in a large prospective Canadian cohort of patients with early RA in a real-world setting. Low SES

Table 6. Review of literature studying socioeconomic status in rheumatoid arthritis (RA), early RA, and early inflammatory arthritis (EIA). Low SES is associated with worse outcomes.

Author, Year, Study Type	Definition of SES	Patient Population	Mean Followup	Outcomes Mortality	Erosions on Radiograph	HAQ	Other Outcomes	Pain	Other Findings
Maiden[1] (1999) retrospective cohort	Carstairs score[17]	n = 200	None	↑					
ERAS[2] (2000) prospective cohort	Difference between Carstairs score[17] fifth percentile and 95th percentile	n = 869 with EIA < 2 yrs, prior to DMARD	3 yrs	Not significant at 3 yrs	Not significant	Baseline: OR 1.87 for an above-median HAQ. 3 yrs: OR 1.74 adjusted for age, sex, treatment center, baseline HAQ	Baseline: OR 1.77 for an above-median joint score. Also worse at 3 yrs	Not significant	Worse functional class at 3 yrs
ERAS[2] (2000) prospective cohort	Education (no high school vs more education)	n = 869 with EIA < 2 yrs	3 yrs	Not significant at 3 yrs	N/A	Worse at baseline and 3 yrs in low education	Worse at 3 yrs in low education	Worse at baseline and 3 yrs in low education	
Jacobi[3] (2003) prospective cohort	Education (less than high school, vs high school completed vs postsecondary school)	n = 878 with RA disease duration 0–15 yrs	2 yrs	N/A	N/A	For disease duration 0–5 yrs, OR for HAQ ≥ 0.5 in low SES: 2.2. No significant difference on followup.	For disease duration 0–5 yrs, OR for DAS28 > 3.3 in low SES: 3.3. No significant difference on followup.	N/A	In ERA: Less use of allied healthcare in low SES, more depression and worse QoL. No differences in RA duration 5–15 yrs. At 2 yrs followup low SES group significantly improved QoL
Harrison[5] (2005) retrospective cohort	Townsend score[18]	n = 466 with RA	3 yrs	No significant difference at 3 yrs	No significant difference at baseline	Worse at baseline and 3 yrs in low SES	DAS28 worse at baseline, not at 3 yrs in low SES	Worse at baseline in low SES	Worse baseline: SF-36 MCS, EQ-5D utility score in low SES
Harrison[6] (2009) retrospective cohort	IMD[19] and social class (occupation)	n = 1393 with EIA	3 yrs		N/A	No differences across social classes, but significant change in HAQ over 3 yrs across IMD quartiles. No significant difference across social classes	Differences in SJC and TJC over 3 yrs across social classes	N/A	
Massardo[9] (2012) prospective cohort	Modified Graffar method[20]	n = 1093 with EIA in Latin America	None	N/A	Not significant	Significantly higher HAQ in low SES	Significantly higher DAS28 in low SES	Significantly higher pain score in low SES	Widowed, separated, divorced status associated with worse HAQ. PtGA, PGA, and ESR significantly worse in low SES
Camacho[8] (2012) prospective cohort	IMD[19]	n = 553 with EIA	None	N/A	N/A	Significantly higher HAQ in low SES	Significantly higher DAS28 in low SES	N/A	Learned helplessness mediated the SES effect on outcomes

↑ = increased. ERA: early rheumatoid arthritis; QoL: quality of life; IMD: Index of Multiple Deprivation; DMARD: disease-modifying antirheumatic drug; SES: socioeconomic status; HAQ: Health Assessment Questionnaire; MCS: mental component score; SF-36: Medical Outcomes Study Short Form-36; DAS28: 28-joint Disease Activity Score; PtGA: patient's global assessment; PGA: physician's global assessment; N/A: not applicable; ESR: erythrocyte sedimentation rate; EQ-5D: EuroQol questionnaire; SJC: swollen joint count; TJC: tender joint count.

as defined by education was associated with significantly worse DAS28, ESR, and PCS of SF-12 in patients at baseline. The negative effects of SES are overcome with initiation of treatment, such that by 1 year the between-group differences in disease activity seen at baseline disappeared. Low SES as defined by income was

associated with significantly worse HAQ, CDAI, SDAI, PtGA, and pain in patients at presentation. HAQ is persistently worse in low-income patients up to 1 year of followup. All other disease activity indices such as CDAI, SDAI, PtGA, and pain VAS are not significantly different between low-income and high-income groups by the 1-year followup visit. This study shows that SES worsens baseline disease activity in patients presenting with early RA. Although many of these differences resolved by 1 year, the persistence of worse HAQ in low SES patients was observed.

APPENDIX 1. CATCH investigators: Vandana Ahluwalia, Pooneh Akhavan, Murray Baron, William Bensen, Louis Bessette, Gilles Boire, Vivian P. Bykerk, Ines Colmegna, Boulos Haraoui, Carol A. Hitchon, Shahin Jamal, Edward C. Keystone, Alice Klinkhoff, Majed Kraishi, Maggie Larche, Chris Lyddell, Bindu Nair, Chris Penney, Janet E. Pope, Laurence Rubin, J. Carter Thorne, and Michel Zummer.

REFERENCES

1. Maiden N, Capell HA, Madhok R, Hampson R, Thomson EA. Does social disadvantage contribute to the excess mortality in rheumatoid arthritis patients? Ann Rheum Dis 1999;58:525-9.
2. ERAS Study Group. Socioeconomic deprivation and rheumatoid disease: What lessons for the health service? Ann Rheum Dis 2000;59:794-9.
3. Jacobi CE, Mol GD, Boshuizen HC, Rupp I, Dinant HJ, Van Den Bos GA. Impact of socioeconomic status on the course of rheumatoid arthritis and on related use of health care services. Arthritis Rheum 2003;49:567-73.
4. Marra CA, Lynd LD, Esdaile JM, Kopec J, Anis AH. The impact of low family income on self-reported health outcomes in patients with rheumatoid arthritis within a publicly funded health-care environment. Rheumatology 2004;43:1390-7.
5. Harrison MJ, Tricker KJ, Davies L, Hassell A, Dawes P, Scott DL, et al. The relationship between social deprivation, disease outcome measures, and response to treatment in patients with stable, long-standing rheumatoid arthritis. J Rheumatol 2005;32:2330-6.
6. Harrison MJ, Farragher TM, Clarke AM, Manning SC, Bunn DK, Symmons DP. Association of functional outcome with both personal- and area-level socioeconomic inequalities in patients with inflammatory polyarthritis. Arthritis Rheum 2009;61:1297-304.
7. Margaretten M, Barton J, Julian L, Katz P, Trupin L, Tonner C, et al. Socioeconomic determinants of disability and depression in patients with rheumatoid arthritis. Arthritis Care Res 2011; 63:240-6.
8. Camacho EM, Verstappen SM, Symmons DP. Association between socioeconomic status, learned helplessness, and disease outcome in patients with inflammatory polyarthritis. Arthritis Care Res 2012;64:1225-32.
9. Massardo L, Pons-Estel BA, Wojdyla D. Early rheumatoid arthritis in Latin America: low socioeconomic status related to high disease activity at baseline. Arthritis Care Res 2012;64:1135-43.
10. Pyne L, Bykerk VP, Boire G, Haraoui B, Hitchon C, Thorne JC, et al; CATCH Investigators. Increasing treatment in early rheumatoid arthritis is not determined by the disease activity score but by physician global assessment: results from the CATCH study. J Rheumatol 2012;39:2081-7.
11. Fries J, Spitz P, Kraines R, Holman H. Measurement of patient outcome in arthritis. Arthritis Rheum 1980;23:137-45.
12. Linde L, Sørensen J, Østergaard M, Hørlev-Petersen K, Rasmussen C, Vendelbo D, et al. What factors influence the health status of patients with rheumatoid arthritis measured by the SF-12v2 health survey and the health assessment questionnaire? J Rheumatol 2009;36:2183-9.
13. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO, et al. 2010 rheumatoid arthritis classification criteria: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis Rheum 2010;62:2569-81.
14. Yazici Y, Kautiainen H, Sokka T. Differences in clinical status measures in different ethnic/racial groups with early rheumatoid arthritis: implications for interpretation of clinical trial data. J Rheumatol 2007;34:311-5.
15. O'Neill J, Rader T, Guillemin F, Boonen A, Christensen R, Lyddiatt A, et al. Including health equity considerations in development of instruments for rheumatology research: an introduction to a novel OMERACT paradigm. J Rheumatol 2014;41:150-2.
16. Schmajuk G, Trivedi AN, Solomon DH, Yelin E, Trupin L, Chakravarty EF, et al. Receipt of disease-modifying antirheumatic drugs among patients with rheumatoid arthritis in Medicare managed care plans. JAMA 2011;305:480-6.
17. Carstairs V. Deprivation indices: their interpretation and use in relation to health. Review. J Epidemiol Community Health 1995;49 Suppl 2:S3-8.
18. Adams J, Ryan V, White M. How accurate are Townsend Deprivation Scores as predictors of self-reported health? A comparison with individual level data. J Public Health 2005;27:101-6.
19. Adams J, White M. Removing the health domain from the Index of Multiple Deprivation 2004-effect on measured inequalities in census measure of health. J Public Health 2006;28:379-83.
20. Radrigan ME, Guerrero F, Gallardo I, Torres Goitia J, Barriga R. [Environment, nutrition and intellectual development]. [Article in Spanish] Bol Med Hosp Infant Mex 1979;36:711-24.