The Journal of Rheumatology 2023;50:1047–57
doi:10.3899/jrheum.220871
First Release February 15 2023

The Journal of Rheumatology

Insurance Status and Tumor Necrosis Factor Inhibitor Initiation Among Children With Juvenile Idiopathic Arthritis in the CARRA Registry

Jordan E. Roberts[1], Kathryn Williams[2], Johnathan Dallas[2], Mary Eckert[3], Livie Huie[4], Emily Smitherman[4], William D. Soulsby[5], Yongdong Zhao[6], and Mary Beth F. Son[2], for the CARRA Registry Investigators

ABSTRACT. ***Objective.*** Prompt escalation to tumor necrosis factor inhibitors (TNFis) is recommended for children with juvenile idiopathic arthritis (JIA) and ongoing disease activity despite treatment with conventional disease-modifying antirheumatic drugs (cDMARDs). It is unknown whether these recommendations are equitably followed for children with different insurance types. We assessed the association of insurance coverage on the odds and timing of TNFi use.

Methods. We conducted a retrospective study of children with newly diagnosed JIA in the Childhood Arthritis and Rheumatology Research Alliance (CARRA) Registry. We compared the odds of starting a TNFi in the first year and time from cDMARD to TNFi initiation between those with public and private insurance.

Results. We identified 1086 children with new JIA diagnoses. Publicly insured children had significantly higher active joint counts and parent/patient global assessment scores at the enrollment visit. They were also more likely to have polyarticular arthritis compared to those with private insurance. Odds of any TNFi use in the first year did not differ between publicly and privately insured children. Publicly insured children were escalated from cDMARD to TNFi more quickly than privately insured children.

Conclusion. Children who were publicly insured had more severe disease and polyarticular involvement at registry enrollment compared to those who were privately insured. Whereas overall TNFi use did not differ between children with different insurance types, publicly insured children were escalated more quickly, consistent with their increased disease severity. Further research is needed to determine why insurance coverage type is associated with disease severity, including how other socioeconomic factors affect presentation to care.

Key Indexing Terms: antirheumatic agents, health insurance, juvenile idiopathic arthritis, Medicaid, social determinants of health, tumor necrosis factor inhibitors

Poverty and insurance status are associated with worse disease severity and outcomes in juvenile idiopathic arthritis (JIA).[1-4] The extent to which disparities in JIA outcomes are mediated by differences in access to pediatric rheumatology care, including timely administration of biologic medications, is unknown. JIA treatment guidelines advise initiating tumor necrosis factor inhibitors (TNFis) for children with ongoing disease activity despite treatment with conventional disease-modifying antirheumatic drugs (cDMARDs).[5-7] Growing evidence suggests that the use of biologic medications, including TNFis, earlier in the

JER was supported by the National Institutes of Health (NIH; grant no. 5T32AI007512), the Childhood Arthritis and Rheumatology Research Alliance (CARRA)/Arthritis Foundation Fellow Grant, and a Lupus Foundation of America Gary S. Gilkeson Career Development Award. ES was supported by a Rheumatology Research Foundation Investigator Award. YZ received research support from Bristol-Myers Squibb, CARRA, the American College of Rheumatology/European Alliance of Associations for Rheumatology, the Washington Research Foundation, and the Rheumatology Research Foundation; and received consultant fees from Novartis. MBFS was supported by the Samara Jan Turkel Center.

[1]J.E. Roberts, MD, MPH, Seattle Children's Hospital, University of Washington School of Medicine, Seattle, Washington, and Seattle Children's Research Institute, Center for Clinical and Translational Research, Seattle, Washington, and Boston Children's Hospital, Harvard Medical School, Boston, Massachusetts; [2]K. Williams, MS, J. Dallas, BA, M.B.F. Son, MD, Boston Children's Hospital, Harvard Medical School, Boston, Massachusetts; [3]M. Eckert, BS, Seattle Children's Hospital, University of Washington School of Medicine, Seattle, Washington; [4]L. Huie, BA, E. Smitherman, MD, MSc, University of Alabama at Birmingham, Children's of Alabama, Birmingham, Alabama; [5]W.D. Soulsby, MD, University of California at San Francisco, San Francisco, California; [6]Y. Zhao, MD, PhD, Seattle Children's Hospital, University of Washington School of Medicine, and Seattle Children's Research Institute, Center for Clinical and Translational Research, Seattle, Washington, USA.

The authors declare no conflicts of interest relevant to this article.

Address correspondence to Dr. J.E. Roberts, Seattle Children's Hospital, 4800 Sand Point Way NE, Mail Stop: MA.7.110, Seattle, WA 98105, USA. Email: jordan.roberts@seattlechildrens.org.

Accepted for publication December 6, 2022.

© 2023 The Journal of Rheumatology

Downloaded on November 7, 2026 from www.jrheum.org

disease course may improve remission rates and possibly long-term outcomes,[8-15] and early biologic use for JIA has increased.[16,17]

Among adults with rheumatoid arthritis, public insurance and no insurance are associated with delays in starting cDMARDs,[18] and coverage by insurance with step therapy requirements is associated with worse outcomes.[19] Insurance coverage of biologic medications varies by plan, and requirements for prior authorizations and other utilization management strategies to restrict use of biologic medications may delay recommended therapies and increase steroid burden.[20,21] However, the association of insurance type with timing of biologic medication initiation has not been studied in a large, multicenter JIA cohort.

We sought to examine whether medical insurance type predicts access to and timely use of biologic medication in JIA. In this study, we assessed the association of private vs nonmilitary public insurance coverage with the odds of use of TNFi, as well as the timing of escalation of therapy to TNFi in children with newly diagnosed, nonsystemic JIA using a national multicenter cohort. As insurance type may also affect timely initiation of biologic therapy through differential access to pediatric rheumatology care, we also assessed disease characteristics of all enrolled children with JIA at the time of first presentation to pediatric rheumatology care by insurance coverage type.

METHODS

Data source and patient population. We conducted a retrospective study of children with newly diagnosed (ie, within 90 days of enrollment) nonsystemic JIA enrolled in the Childhood Arthritis and Rheumatology Research Alliance (CARRA) Registry from 2015 to 2021 for at least 12 months and treated at a US site. This prospective observational disease registry collects detailed clinical and demographic information from participants at over 60 pediatric rheumatology centers.[22-24] Children with idiopathic uveitis, inflammatory bowel disease, psoriasis, other undefined autoinflammatory disease, history of tuberculosis, and prior use of any TNFi were excluded. Those with a history of macrophage activation syndrome were also excluded given its strong association with systemic-onset JIA subtype, which is not typically treated with TNFi. Children treated with a cDMARD, including methotrexate, leflunomide, or sulfasalazine, within 30 days of their enrollment visit were included in a time-to-TNFi-escalation analysis.

Outcomes and their measurement. TNFi use was defined as a record of any TNFi start, including infliximab, adalimumab, or etanercept, from the date of enrollment visit to 15 months after the enrollment visit date to encompass the 12 months plus 3-month follow-up window used by the CARRA Registry to identify clinical visits. Time from cDMARD to TNFi escalation was defined as the time from the date of first cDMARD use, if prescribed within 30 days of the enrollment visit, to the date of first TNFi use.

Exposures and covariates. Insurance was classified as nonmilitary public insurance (ie, Medicaid, Indian Health Service, or state plan) vs private insurance. Those with no insurance, other insurance, non-US insurance, or military health insurance were excluded. Accuracy of insurance classification was assessed by validating CARRA Registry insurance classification for a sample of 30 patients at each of the 4 large CARRA sites against electronic health record insurance type classification. Race and ethnicity were self-reported by registry participants who could select multiple identities, including "other." Household income and parental education were self-reported. Disease information at enrollment included time since diagnosis, number of active joints, JIA subtype classification, parent/patient visual analog scale (VAS) scores, physician global assessment (PGA) scores, and the clinical Juvenile Arthritis Disease Activity Score (cJADAS),[25] which is a composite of active joint counts, parent/patient VAS scores, and PGA scores.

Statistical analysis. Descriptive statistics were performed to characterize the new-onset nonsystemic JIA cohort with 12 months or more of follow-up. Our primary cohort of interest was restricted to those diagnosed within 90 days of enrollment who had either public or private medical insurance, which limited our ability to assess differences in timing of presentation between insurance types and among the uninsured. Accordingly, we also conducted prespecified descriptive analyses of the entire JIA registry during the same time period as the primary analysis.

We compared the odds of starting a TNFi (ie, etanercept, infliximab, or adalimumab) in the first year of registry enrollment between those with public and private insurance using logistic regression. Among those treated with a cDMARD (ie, methotrexate, sulfasalazine, or leflunomide) at the enrollment visit, the length of time from cDMARD initiation until escalation to TNFi was analyzed using multivariable Cox proportional hazard regression. Hazard ratios (HRs) and odds ratios for TNFi use were calculated for a 15-month exposure window to allow for inclusion of 1-year registry follow-up visits. A sensitivity analysis was conducted including all children with 6 months or more of follow-up, rather than 12 months as required in the primary analysis, to assess the effect of loss to follow-up on time to TNFi escalation. Site of care was used as a random effect in multivariable models to account for practice differences between sites. Multiple imputation with 20 imputations was used for missing data. Analysis was performed using SAS (version 9.4; SAS Institute Inc.) and R (version 4.0.3; R Foundation for Statistical Computing).

Ethics approval. This study was determined to be exempt from the Boston Children's Hospital Institutional Review Board (protocol no. P00037938).

RESULTS

Insurance plan type validation. Accuracy of insurance classification was assessed by comparing the CARRA Registry insurance type classification to the insurance type listed in the electronic health record for a sample of 30 patients at each of 4 CARRA sites. Overall, 111 out of 120 participants' insurance types (92.5%) were correctly classified as public vs private, with accuracy at each site ranging from 90% to 96.7%.

Cohort characteristics. We identified 1086 eligible children with new diagnoses of nonsystemic JIA, of whom 585 were started on a cDMARD at the enrollment visit. A Consolidated Standards of Reporting Trials diagram of eligible participants is presented in Figure 1. The mean age at the enrollment visit was 9.1 (SD 5.1) years, and 70% of the participants were female (Table 1). Children with public insurance were more likely to identify as Black, Hispanic, or other race, and were less likely to identify as White compared to children with private insurance, and reported lower levels of household income and parental education than privately insured children. Publicly insured children had significantly higher active joint counts, parent/patient VAS scores, and cJADAS scores at enrollment compared to privately insured children. Publicly insured children were also more likely to have polyarticular arthritis subtypes (51.9%) compared to those with private insurance (37.5%).

Odds of TNFi use. In total, 54.8% (448/818) of children who were privately insured started a TNFi during the 1-year follow-up period, compared to 59.3% (159/268) of those who were publicly insured ($P = 0.22$). The odds of TNFi use in the first year did not

Downloaded on November 7, 2026 from www.jrheum.org

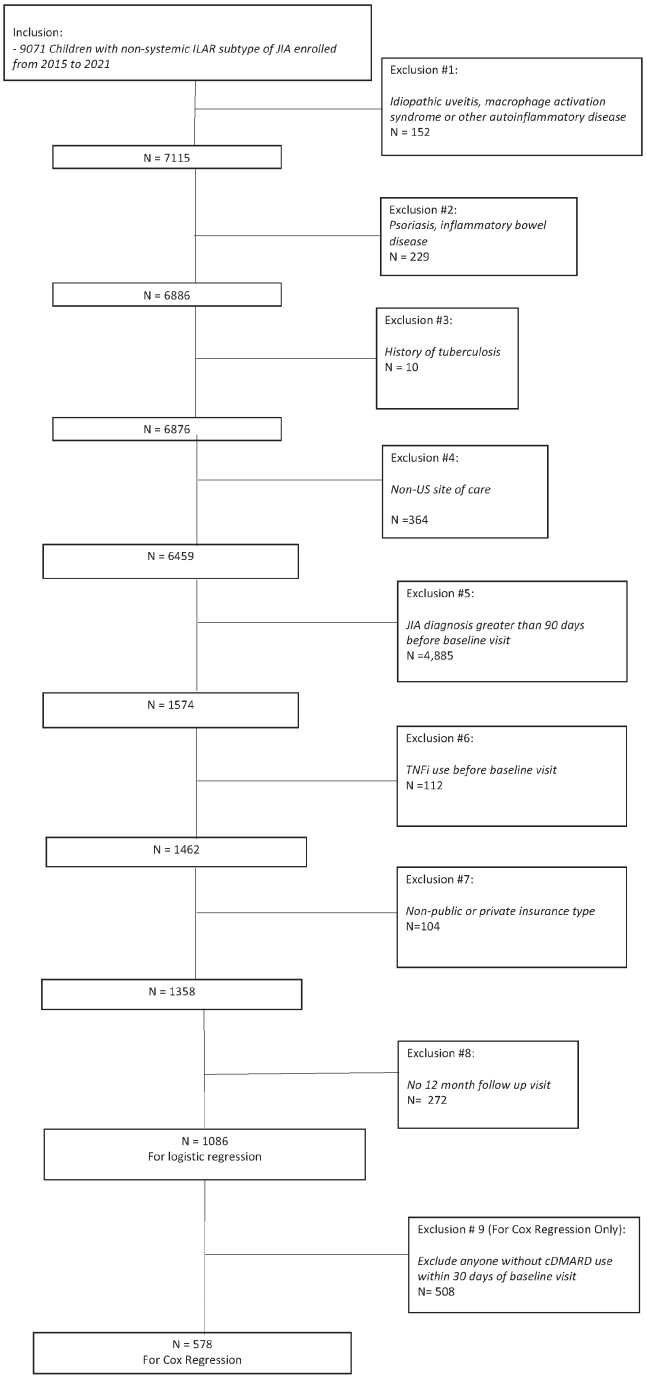

Figure 1. Consolidated Standards of Reporting Trials diagram. cDMARD: conventional disease-modifying antirheumatic drug; ILAR: International League of Associations for Rheumatology; JIA: juvenile idiopathic arthritis; TNFi: tumor necrosis factor inhibitor.

differ between publicly and privately insured children (Table 2). Although Black race, older age, and parental education level of high school graduate or lower were significantly associated with higher odds of TNFi use in the univariate analyses, these were not significant predictors in the adjusted models. In the multivariate analysis, which was fully adjusted with site of care, significant predictors of TNFi use included undifferentiated, enthesitis-related, or rheumatoid factor–positive polyarticular arthritis subtype; higher active joint count; and higher PGA score. In logistic regression stratified by insurance type, these remained significant predictors for children with private insurance; among publicly insured children, only enthesitis-related arthritis and higher PGA scores were independent predictors of TNFi use (Table 3).

Time to escalation from cDMARD to TNFi. The median time to initiate a TNFi among those started on cDMARDs at the enrollment visit was 8.3 (IQR 0-18.5) weeks for those with public insurance and 11.6 (IQR 5-24) weeks for those with private insurance (P = 0.002). Twenty-two percent of publicly insured children (n = 33) started on cDMARD at enrollment visit were simultaneously initiated on a TNFi, compared with only 10% (n = 43) of those privately insured. Time to escalation was significantly different between publicly and privately insured children in the log-rank test (P = 0.02; Figure 2). In the unadjusted Cox proportional hazard regression, children with public insurance were escalated more quickly to TNFi (HR 1.32), which persisted when adjusted for demographic and disease-related covariates (HR 1.45) and for site of care (HR 1.45; Table 4). When fully adjusted for site of care, other significant predictors of shorter time to escalation included enthesitis-related or rheumatoid factor–positive polyarticular arthritis subtype, higher active joint count, and higher PGA score. In the Cox proportional hazard model stratified by insurance type, Asian race was associated with longer time to escalation (HR 0.08, 95% CI 0.01-0.70) only among publicly insured children, whereas the other independent predictors identified in the unstratified model remained consistent across insurance type groups (Supplementary Table S1, available with the online version of this article).

In a sensitivity analysis including children with 6 months or more of follow-up (n = 692), publicly insured children were escalated more quickly to TNFi compared to those with private insurance, with a log-rank test P value of 0.008 and an HR of 1.38 in the fully adjusted model (Supplementary Figure S1 and Supplementary Table S2, available with the online version of this article). Enthesitis-related or rheumatoid factor–positive polyarticular arthritis subtype, higher active joint count, and higher PGA score continued to be significant predictors of shorter time to TNFi escalation in the fully adjusted multivariate model among the 6-month or greater follow-up cohort.

Disease characteristics and timing of pediatric rheumatology care among all enrolled JIA registry participants. We conducted descriptive analyses of all children with JIA enrolled in the CARRA Registry and treated at US sites of care, including those with no insurance or a diagnosis greater than 90 days prior to enrollment and, therefore, excluded from the primary analyses (Supplementary Table S3, available with the online version of this article). Overall, 1.3% of enrolled children with JIA were uninsured; 25.5% had nonmilitary public insurance and 73.2% had private insurance. The mean age of the children was 11.3 (SD 4.9) years and 70.5% were female. Most patients (80.3%) were White, 6% were Black, and 11.4% were Hispanic. The insurance groups differed significantly regarding their demographics; publicly insured and uninsured children reported lower

Downloaded on November 7, 2026 from www.jrheum.org

Table 1. Patient characteristics at enrollment visit by insurance status.

	All Patients, N = 1086	Public Insurance, n = 268	Private Insurance, n = 818	*P*
Age, mean (SD)	9.1 (5.1)	9.1 (5.0)	9.2 (5.1)	0.74
Male	324 (29.8)	85 (31.7)	239 (29.2)	0.44
Race/ethnicity[a]				
White	879 (80.9)	175 (65.3)	704 (86.1)	< 0.001
Black	72 (6.6)	30 (11.2)	42 (5.1)	0.001
Hispanic	117 (10.8)	63 (23.5)	54 (6.6)	< 0.001
Asian	57 (5.2)	11 (4.1)	46 (5.6)	0.43
Native American, American Indian, or Alaska Native	13 (1.2)	9 (3.4)	4 (0.5)	< 0.001
Middle Eastern/North African	9 (0.8)	2 (0.8)	7 (0.9)	> 0.99
Native Hawaiian or other Pacific Islander	4 (0.4)	1 (0.4)	3 (0.4)	> 0.99
Other	10 (0.9)	3 (1.1)	7 (0.9)	0.72
Prefer not to state	17 (1.6)	3 (1.1)	14 (1.7)	0.78
Self-reported household income, US $, n = 114 missing				< 0.001
< 25,000	82 (8.4)	69 (28.6)	13 (1.8)	
25,000-49,000	137 (14.1)	78 (32.4)	59 (8.1)	
50,000-74,000	127 (13.1)	34 (14.1)	93 (12.7)	
75,000-99,000	112 (11.5)	10 (4.2)	102 (14)	
100,000-150,000	201 (20.7)	11 (4.6)	190 (26)	
> 150,000	181 (18.6)	8 (3.3)	173 (23.7)	
Prefer not to state	132 (13.6)	31 (12.9)	101 (13.8)	
Self-reported parental education, n = 31 missing				< 0.001
High school graduate or less	157 (14.9)	78 (29.9)	79 (10)	
College	472 (44.7)	124 (47.5)	348 (43.8)	
Graduate school	290 (27.5)	25 (9.6)	265 (33.4)	
Prefer not to state	136 (12.9)	34 (13)	102 (12.9)	
Arthritis subtype				< 0.001
Enthesis-related arthritis	127 (11.7)	20 (7.5)	107 (13.1)	
Oligoarthritis	414 (38.1)	83 (31)	331 (40.5)	
Polyarthritis (RF–)	335 (30.8)	98 (36.6)	237 (29)	
Polyarthritis (RF+)	111 (10.2)	41 (15.3)	70 (8.6)	
Psoriatic arthritis	62 (5.7)	16 (6)	46 (5.6)	
Undifferentiated arthritis	37 (3.4)	10 (3.7)	27 (3.3)	
Active joint count, n = 11 missing, mean (SD)	6.4 (8.3)	7.1 (8.5)	6.2 (8.3)	0.04
Time from diagnosis to enrollment visit, wks, mean (SD)	3.6 (4.0)	3.7 (4.1)	3.6 (3.9)	0.98
Physician VAS, n = 45 missing, mean (SD)	3.9 (2.6)	4.2 (2.7)	3.8 (2.5)	0.06
Parent/patient VAS, n = 165 missing, mean (SD)	3.4 (2.7)	3.8 (2.7)	3.3 (2.6)	0.006
cJADAS, n = 201 missing, mean (SD)	14.0 (11.4)	15.6 (11.8)	13.5 (11.3)	0.009

Data are in n (%) unless otherwise indicated. [a] Participants could select multiple race and/or ethnicity categories. cJADAS: clinical Juvenile Arthritis Disease Activity Score; RF: rheumatoid factor; VAS: visual analog scale.

household incomes and parental education levels. Racial and ethnic composition also differed significantly by insurance type, with more White and Asian children in the privately insured group, more Hispanic and Black children in the publicly insured and uninsured groups, and more Native American/American Indian children in the publicly insured group.

Disease characteristics also differed by insurance type, with uninsured and publicly insured children overrepresented in the polyarticular subtypes and underrepresented in the oligoarticular subtype. Children with no insurance or public insurance had significantly higher active joint counts, PGA scores, patient/parent VAS scores, and cJADAS scores compared to those with private insurance, with most disease severity metrics showing a trend with the highest severity/activity in the uninsured group, followed by the publicly insured group, and the lowest severity/activity in the privately insured group. The time from symptom onset to the first pediatric rheumatology visit was a median of 14.8 weeks in the uninsured group, 11.7 weeks in the publicly insured group, and 10.7 weeks in the privately insured group ($P = 0.03$). In a pairwise comparison, the time to the first pediatric rheumatology visit was also significantly longer in publicly insured vs privately insured enrollees ($P = 0.02$). The time from symptom onset to JIA diagnosis was a median of 15.1 weeks in the uninsured group, 13.3 weeks in the publicly insured group, and 12.9 weeks in the privately insured group; the differences were not statistically significant.

DISCUSSION

The odds of TNFi use in the first year of registry enrollment among children with newly diagnosed JIA did not differ

Downloaded on November 7, 2026 from www.jrheum.org

Table 2. Logistic regression model for any TNFi initiation in first year of registry enrollment.

	Unadjusted OR (95% CI)	Adjusted OR[a] (95% CI)	Adjusted OR With Site of Care[b] (95% CI)
Public insurance (ref private)	1.21 (0.91-1.59)	1.07 (0.72-1.60)	1.13 (0.75-1.71)
Male	1.13 (0.87-1.47)	1.032 (0.74-1.41)	1.03 (0.75-1.43)
Age, per 1-yr increase	1.09 (1.07-1.12)**	1.03 (1.00-1.06)	1.02 (0.99-1.05)
Race/ethnicity			
White	0.76 (0.56-1.03)	1.06 (0.58-1.93)	1.15 (0.62-2.16)
Black	2.15 (1.26-3.65)*	1.54 (0.75-3.14)	1.64 (0.78-3.42)
Hispanic	1.11 (0.75-1.63)	0.92 (0.50-1.70)	1.01 (0.53-1.91)
Asian	0.81 (0.47-1.38)	0.74 (0.37-1.49)	0.79 (0.38-1.63)
Native American, American Indian, or Alaska Native	0.92 (0.31-2.75)	0.82 (0.23-2.95)	0.87 (0.23-3.28)
Middle Eastern/North African	2,78 (0.58-13.46)	1.60 (0.27-9.34)	1.56 (0.25-9.70)
Native Hawaiian or other Pacific Islander	0.79 (0.11-5.61)	0.24 (0.02-2.31)	0.25 (0.03-2.37)
Other	1.85 (0.48-7.19)	2.66 (0.56-12.54)	2.78 (0.59-13.07)
Prefer not to state	0.89 (0.34-2.31)	0.73 (0.20-2.62)	0.81 (0.22-2.95)
Self-reported household income, US $ (ref > 150,000)			
< 25,000	1.14 (0.67-1.93)	0.72 (0.35-1.48)	0.74 (0.35-1.54)
25,000-49,000	1.04 (0.67-1.63)	0.69 (0.40-1.20)	0.67 (0.36-1.25)
50,000-74,000	1.25 (0.79-1.98)	1.05 (0.60-1.83)	1.00 (0.56-1.78)
75,000-99,000	0.87 (0.54-1.40)	0.70 (0.44-1.11)	0.66 (0.37-1.16)
100,000-150,000	0.83 (0.55-1.25)	0.69 (0.44-1.10)	0.67 (0.41-1.08)
Prefer not to state	0.94 (0.60-1.48)	0.65 (0.38-1.11)	0.63 (0.36-1.09)
Self-reported parental education (ref graduate school)			
High school graduate or less	1.53 (1.02-2.28)*	1.30 (0.79-2.13)	1.31 (0.79-2.20)
College	1.18 (0.88-1.58)	1.11 (0.77-1.60)	1.13 (0.79-1.63)
Prefer not to state	1.12 (074-1.69)	0.96 (0.59-1.55)	1.09 (0.64-1.84)
Arthritis subtype (ref oligoarthritis)			
Enthesitis-related arthritis	8.13 (4.99-13.35)**	4.88 (2.84-8.37)**	5.11 (2.91-8.99)**
Polyarthritis (RF−)	3.40 (2.51-4.59)**	1.40 (0.95-2.08)	1.40 (0.94-2.10)
Polyarthritis (RF+)	9.18 (5.38-15.65)**	2.73 (1.43-5.22)*	2.76 (1.42-5.35)*
Psoriatic arthritis	1.78 (1.04-3.04)*	1.27 (0.71-2.28)	1.31 (0.71-2.41)
Undifferentiated arthritis	3.50 (1.73-7.08)**	2.20 (1.03-4.72)*	2.39 (1.09-5.25)*
Active joint count at enrollment, per 1-joint increase	1.12 (1.09-1.15)**	1.05 (1.02-1.08)**	1.04 (1.02-1.08)**
Physician VAS, per 1-point increase	1.42 (1.34-1.51)**	1.19 (1.10-1.28)**	1.22 (1.12-1.32)**
Parent/patient VAS, per 1-point increase	1.24 (1.18-1.33)**	1.07 (1.00-1.14)	1.07 (0.99-1.14)

[a] Includes all listed covariates. [b] Includes all listed covariates and site of care as random effect. *$P < 0.05$. **$P < 0.001$. OR: odds ratio; ref: reference; RF: rheumatoid factor; TNFi: tumor necrosis factor inhibitor; VAS: visual analog scale.

between those who were publicly vs privately insured. However, among those children who were started on cDMARDs at the enrollment visit, those with public insurance were escalated more quickly to TNFi inhibitors, which was largely driven by a higher proportion of children with public insurance starting biologic medications simultaneously with cDMARDs at enrollment visits. This may be a result of differences in disease severity at diagnosis, as we found that children who were publicly insured were more likely to have polyarticular subtypes and had higher average active joint counts, cJADAS, and PGA scores than those who were privately insured. In both insurance groups, polyarticular disease and enthesis-related arthritis were associated with higher odds of TNFi use and faster escalation from cDMARDs. Among all enrolled children with JIA, without restricting to new diagnoses, those who were uninsured or publicly insured had longer wait times between symptom onset and the first pediatric rheumatology visit compared to children with private insurance.

Consistent with our prior single-center study demonstrating comparable length of insurance-related delays in TNFi approval and initiation between children who had private and public medical insurance and high overall rates of approval, we did not observe a difference in odds of use of TNFi over the first year in those with different medical insurance types.[20] This contrasts with earlier literature in adults with rheumatoid arthritis showing an association of public insurance with longer time to start biologic DMARDs and/or cDMARDs,[18] which may reflect differences in pediatric rheumatology vs adult care or changes in the insurance landscape since that study was conducted. Our finding of longer time to escalation to TNFi in the privately insured group may also reflect increasing barriers to biologic specialty medication use among those with private insurance plans, including prior authorization and formulary restrictions[20,21] and growing rates of underinsurance among children enrolled in commercial insurance plans.[26]

Children who were publicly insured presented with more severe disease, including higher joint counts, higher PGA scores, and more polyarticular disease compared with the privately insured children. We demonstrated significant delays in time from

Downloaded on November 7, 2026 from www.jrheum.org

Table 3. Logistic regression model of TNFi initiation in first year by insurance type.

	Public Insurance, n = 268			Private Insurance, n = 818		
	Unadjusted OR (95% CI)	Adjusted OR[a] (95% CI)	Adjusted OR With Site of Care[b] (95% CI)	Unadjusted OR (95% CI)	Adjusted OR[a] (95% CI)	Adjusted OR With Site of Care[b] (95% CI)
Male	1.29 (0.76-2.20)	1.44 (0.69-2.98)	1.4 (0.65-3.03)	0.93 (0.69-1.26)	0.96 (0.67-1.38)	0.97 (0.67-1.41)
Age, per 1-yr increase	1.07 (1.02-1.13)*	1.01 (0.94-1.08)	1.0 (0.93-1.07)	1.10 (1.07-1.13)**	1.03 (1.00-1.07)	1.03 (0.99-1.06)
Race/ethnicity						
White	0.82 (0.49-1.38)	1.29 (0.40-4.19)	1.34 (0.38-4.78)	0.76 (0.51-1.14)	1.08 (0.50-2.31)	1.15 (0.53-2.52)
Black	1.42 (0.64-3.18)	1.24 (0.35-4.34)	1.47 (0.39-5.47)	2.77 (1.34-5.71)*	1.97 (0.74-5.28)	2.11 (0.77-5.75)
Hispanic	1.15 (0.65-2.06)	1.15 (0.33-4.0)	1.40 (0.38-5.17)	0.96 (0.55-1.66)	0.88 (0.41-1.90)	0.90 (0.41-1.98)
Asian	0.56 (0.17-1.87)	0.45 (0.08-2.56)	0.48 (0.07-3.22)	0.90 (0.49-1.62)	0.91 (0.41-2.01)	0.93 (0.41-2.12)
Native American, American Indian, or Alaska Native	1.39 (0.34-5.66)	2.25 (0.35-14.43)	2.66 (0.36-19.62)	0.27 (0.03-2.64)	0.19 (0.01-2.55)	0.20 (0.01-2.83)
Middle Eastern/ North African	–	–	–	2.08 (0.40-10.76)	1.32 (0.21-8.67)	1.28 (0.19-8.79)
Native Hawaiian or other Pacific Islander	–	–	–	1.66 (0.15-18.32)	0.43 (0.03-6.26)	0.47 (0.03-6.69)
Other	1.53 (0.56-4.17)	9.06 (0.54-153.09)	5.88 (0.34-102.9)	1.10 (0.24-4.95)	1.01 (0.19-5.46)	1.10 (0.20-6.02)
Prefer not to state	1.38 (0.12-5.36)	0.57 (0.02-13.95)	0.74 (0.03-19.09)	0.82 (0.29-2.37)	0.83 (0.20-3.55)	0.85 (0.20-3.68)
Self-reported household income, US $ (ref > 150,000)						
< 25,000	0.39 (0.05-2.85)	0.48 (0.03-6.83)	0.50 (0.03-9.34)	0.77 (0.25-2.33)	0.59 (0.15-2.26)	0.59 (0.15-2.37)
25,000-49,000	0.27 (0.04-2.00)	0.32 (0.02-4.66)	0.35 (0.02-6.88)	1.40 (0.76-2.59)	0.75 (0.36-1.58)	0.74 (0.35-1.59)
50,000-74,000	0.36 (0.05-2.78)	0.47 (0.03-7.29)	0.47 (0.02-9.80)	1.37 (0.82-2.29)	1.18 (0.64-2.17)	1.09 (0.58-2.05)
75,000-99,000	0.27 (0.03-2.86)	0.43 (0.02-9.56)	0.47 (0.02-14.66)	0.88 (0.55-1.43)	0.73 (0.41-1.29)	0.68 (0.38-1.23)
100,000-150,000	0.97 (0.09-11.05)	1.67 (0.06-46.32)	1.97 (0.05-76.17)	0.79 (0.53-1.19)	0.69 (0.43-1.11)	0.66 (0.40-1.07)
Prefer not to state	0.34 (0.04-2.69)	0.30 (0.02-4.79)	0.26 (0.01-5.53)	0.98 (0.59-1.62)	0.75 (0.42-1.33)	0.74 (0.41-1.33)
Self-reported parental education (ref graduate school)						
High school graduate or less	0.75 (0.29-1.95)	0.65 (0.19-2.22)	0.69 (0.18-2.61)	1.80 (1.07-3.03)*	1.60 (0.85-3.03)	1.58 (0.83-3.01)
College	0.67 (0.27-1.65)	0.80 (0.25-2.57)	0.81 (0.23-2.86)	1.25 (0.90-1.72)	1.15 (0.79-1.69)	1.18 (0.80-1.74)
Prefer not to state	0.81 (0.28-2.41)	0.59 (0.14-2.39)	0.68 (0.15-3.17)	1.10 (0.70-1.74)	0.95 (0.55-1.62)	1.05 (0.59-1.87)
Arthritis subtype (ref oligoarthritis)						
Enthesitis-related arthritis	9.51 (2.56-35.28)**	7.46 (1.69-33.04)*	9.53 (1.98-45.93)*	8.01 (4.72-13.60)**	4.77 (2.63-8.66)**	4.78 (2.58-8.84)**
Polyarthritis (RF–)	3.30 (1.79-6.10)**	1.48 (0.64-3.42)	1.45 (0.61-3.48)	3.37 (2.38-4.78)**	1.40 (0.88-2.22)	1.42 (0.88-2.28)
Polyarthritis (RF+)	8.15 (3.21-20.68)**	3.91 (1.14-13.46)*	3.57 (0.97-13.16)	9.45 (4.87-18.34)**	2.63 (1.19-5.81)*	2.70 (1.21-6.06)*
Psoriatic arthritis	1.01 (0.33-3.06)	0.57 (0.14-2.29)	0.58 (0.13-2.67)	2.13 (1.14-3.98)*	1.45 (0.74-2.82)	1.50 (0.75-3.00)
Undifferentiated arthritis	2.52 (0.65-9.68)	2.57 (0.54-12.26)	2.38 (0.47-12.15)	3.91 (1.70-9.00)*	2.49 (1.01-6.13)*	2.62 (1.04-6.56)*
Active joint count at enrollment, per 1-joint increase	1.13 (1.08-1.19)**	1.05 (0.99-1.12)	1.05 (0.99-1.12)	1.11 (1.08-1.15)**	1.05 (1.01-1.09)*	1.05 (1.01-1.09)*
Physician VAS, per 1-point increase	1.45 (1.29-1.64)**	1.30 (1.11-1.54)*	1.33 (1.11-1.59)*	1.35 (1.26-1.44)**	1.15 (1.05-1.26)*	1.18 (1.07-1.30)**
Parent/patient VAS, per 1-point increase	1.27 (1.15-1.41)**	1.13 (0.97-1.30)	1.14 (0.97-1.33)	1.26 (1.19-1.33)**	1.06 (0.98-1.15)	1.05 (0.97-1.14)

[a] Includes all listed covariates. [b] Includes all listed covariates and site of care as random effect. * $P < 0.05$. ** $P < 0.001$. OR: odds ratio; ref: reference; RF: rheumatoid factor; TNFi: tumor necrosis factor inhibitor; VAS: visual analog scale.

arthritis symptom onset to the first pediatric rheumatology visit in children who were uninsured or publicly insured compared to those with private insurance. Although the absolute differences in time from symptom onset to the first pediatric rheumatology appointment were modest in our cohort, it is possible that delays in referral to pediatric rheumatology care play a role in differential disease severity at the time of diagnosis. Prior work on the association of public insurance with timing of the first pediatric rheumatology appointment has shown inconsistent results. One analysis of patients with JIA in the CARRA Registry showed longer time from symptom onset to the first appointment in those with public insurance, whereas another analysis assessing the association between community-level poverty with time to the first pediatric rheumatology appointment did not identify public insurance as an independent predictor of delays.[27,28] Part of the difference in results may stem from whether insurance is considered primarily as a proxy of individual socioeconomic status or as a potential causal exposure, and resultant differences

Downloaded on November 7, 2026 from www.jrheum.org

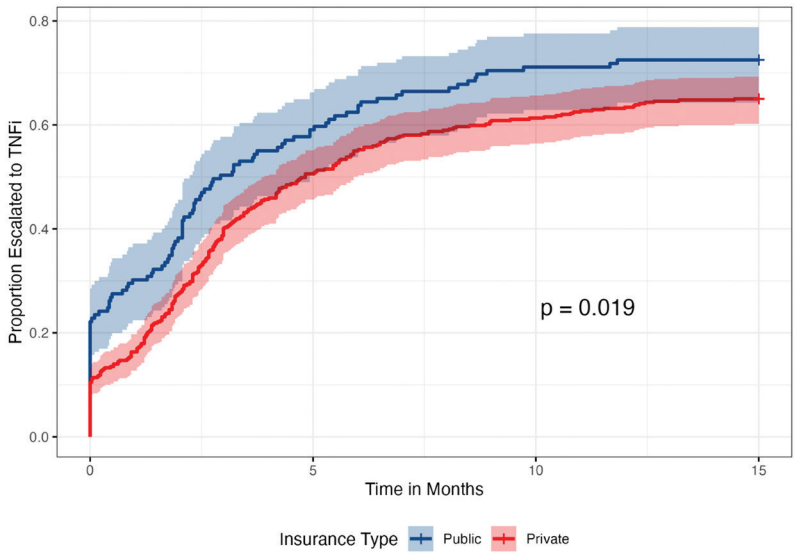

Figure 2. Kaplan-Meier curve of TNFi initiation among children with new-onset JIA started on cDMARDs at enrollment visit. cDMARD: conventional disease-modifying antirheumatic drug; JIA: juvenile idiopathic arthritis; TNFi: tumor necrosis factor inhibitor.

in which variables are included as potential confounders, particularly when multiple measures of socioeconomic status are highly correlated. As income-restricted benefit programs, Medicaid and state plan enrollment are correlated with poverty, which may affect access to medical care through a variety of mechanisms, including delays in recognizing and reporting potential arthritis symptoms, delayed physician referral, and barriers to completing specialty visits. Delays in care may also result from social determinants of health not adequately captured by the socioeconomic status markers available in registry data, such as English-language proficiency, educational attainment, access to transportation, rurality, and distance to care.[29]

While collinearity of medical insurance type with other individual and community-level social determinants of health presents analytic challenges, substantial work suggests that insurance type itself may affect access to pediatric rheumatology care. A high proportion of providers enrolled in commercially administered Medicaid plans saw few or no Medicaid patients, suggesting more limited access than the stated provider networks would indicate.[30] Despite increases in pediatric primary care coverage, access to subspecialty services may still be lacking.[31-33] Nearly 20% of pediatric care for Medicaid enrollees living ≥ 90 minutes from a subspecialist was delivered by adult specialists,[34] which may be particularly important in pediatric rheumatology given the shortage and geographic maldistribution of providers.[35] In another Medicaid cohort, 17% of children with JIA and associated prescriptions were managed entirely by nonspecialists; these children received fewer biologics and cDMARDs.[36] Work in other pediatric subspecialities also showed reduced specialist care among children enrolled in Medicaid vs private insurance, including fewer completed referrals to endocrinologists, allergists, and pulmonologists.[37,38] Such differences in access may explain why we observed a disproportionately low number of Medicaid enrollees in our cohort compared to national rates of coverage.

Comparing treatment and outcomes across types of insurance may also be important in understanding racial and ethnic disparities in JIA outcomes, as children who are Black, Latino, and Native American are far more likely to be covered by Medicaid or other state plans than White children nationally.[39] These differences in racial and ethnic composition between the privately and publicly insured groups were also observed in our cohort. While our finding that children with no insurance or public insurance present with more polyarticular disease likely reflects delays in care among some children, with cases that have progressed from oligoarticular to polyarticular disease at time of initial evaluation, it may also suggest ascertainment bias, with publicly insured or uninsured children with less severe cases and oligoarticular disease receiving no pediatric rheumatology care at all. Finally, the pervasive framing of race and ethnicity as biologic risk factors for diseases in medical education and clinical guidelines[40,41]—often based on epidemiologic data that may reflect ascertainment bias rather than true risk among those from minoritized groups[42,43]—may lead physicians to be less cognizant of the possibility of JIA among children who are not White. In combination with interpersonal racism, this may negatively affect the odds that a non-White child with symptoms suggestive of JIA would be appropriately referred and diagnosed. Prior work has posited that African American children have different JIA phenotypes than White children because of genetic differences.[44,45] However, adequate incorporation of social determinants of health, including insurance type and delays in access to care, may provide an alternative explanation for these observed racial differences and encourage the use of race in rheumatology research as a proxy for structural and interpersonal racism, rather than as a biologic explanation for variation in outcomes.

Increasing evidence suggests a "window period" in which new-onset arthritis may be especially susceptible to early biologic treatment, with timing of treatment initiation affecting

Downloaded on November 7, 2026 from www.jrheum.org

Table 4. Cox proportional hazard model for time to TNFi escalation from cDMARD, including children with a 12-month visit or longer.

	Unadjusted HR (95% CI)	Adjusted HR[a] (95% CI)	Adjusted HR With Site of Care[b] (95% CI)
Public insurance (ref private)	1.32 (1.05-1.64)*	1.45 (1.08-1.96)*	1.45 (1.07-1.96)*
Male	1.13 (0.90-1.41)	1.11 (0.87-1.43)	1.13 (0.87-1.46)
Age, per 1-year increase	1.04 (1.02-1.06)**	1.01 (0.99-1.04)	1.01 (0.98-1.03)
Race/ethnicity			
White	0.87 (0.69-1.11)	1.04 (0.68-1.64)	1.13 (0.69-1.84)
Black	1.16 (0.81-1.64)	1.08 (0.66-1.76)	1.14 (0.68-1.93)
Hispanic	1.20 (0.89-1.65)	1.03 (0.64-1.66)	1.13 (0.68-1.88)
Asian	0.57 (0.33-0.97)*	0.56 (0.30-1.05)	0.63 (0.32-1.21)
Native American, American Indian, or Alaska Native	1.41 (0.58-3.40)	0.99 (0.39-2.56)	1.02 (0.39-2.68)
Middle Eastern/North African	1.49 (0.56-4.00)	1.18 (0.39-3.53)	1.19 (0.37-3.89)
Native Hawaiian or other Pacific Islander	3.43 (0.85-13.89)	3.96 (0.91-17.19)	3.65 (0.69-19.30)
Other	1.32 (0.80-2.18)	1.57 (0.52-4.71)	1.55 (0.49-4.86)
Prefer not to state	1.94 (0.96-3.90)	1.56 (0.65-3.74)	2.19 (0.85-5.65)
Self-reported household income, US $ (ref > 150,000)			
< 25,000	1.30 (0.84-2.02)	1.01 (0.56-1.84)	0.94 (0.52-1.67)
25,000-49,000	0.98 (0.67-1.43)	0.81 (0.50-1.29)	0.76 (0.47-1.22)
50,000-74,000	0.94 (0.63-1.39)	1.00 (0.63-1.57)	0.96 (0.61-1.51)
75,000-99,000	0.84 (0.56-1.25)	0.79 (0.51-1.25)	0.76 (0.48-1.20)
100,000-150,000	0.85 (0.59-1.21)	0.98 (0.66-1.44)	0.93 (0.62-1.37)
Prefer not to state	1.0 (0.68-1.46)	0.93 (0.60-1.43)	0.92 (0.60-1.42)
Self-reported parental education (ref graduate school)			
High school graduate or less	1.03 (0.75-1.42)	0.94 (0.65-1.36)	1.01 (0.69-1.47)
College	0.98 (0.76-1.25)	0.94 (0.71-1.24)	0.99 (0.74-1.31)
Prefer not to state	1.17 (0.83-1.63)	1.05 (0.73-1.50)	1.45 (0.96-2.18)
Arthritis subtype (ref oligoarthritis)			
Enthesitis-related arthritis	2.98 (2.08-4.27)**	2.58 (1.74-3.83)**	2.56 (1.68-3.90)**
Polyarthritis (RF–)	1.64 (1.24-2.17)**	1.07 (0.78-1.48)	1.06 (0.76-1.48)
Polyarthritis (RF+)	2.79 (2.00-3.88)**	1.55 (1.03-2.32)*	1.59 (1.04-2.43)*
Psoriatic arthritis	1.34 (0.83-2.17)	1.17 (0.71-1.91)	1.15 (0.69-1.92)
Undifferentiated arthritis	1.55 (0.87-2.75)	1.15 (0.63-2.09)	1.20 (0.64-2.23)
Active joint count at enrollment, per 1-joint increase	1.04 (1.03-1.05)**	1.02 (1.01-1.04)**	1.03 (1.02-1.04)**
Physician VAS, per 1-point increase	1.16 (1.11-1.22)**	1.10 (1.03-1.17)*	1.14 (1.06-1.21)**
Parent/patient VAS, per 1-point increase	1.09 (1.05-1.14)**	1.03 (0.98-1.08)	1.02 (0.97-1.07)

[a] Includes all listed covariates. [b] Includes all listed covariates and site of care as random effect. * $P < 0.05$. ** $P < 0.001$. cDMARD: conventional disease-modifying antirheumatic drug; HR: hazard ratio; ref: reference; RF: rheumatoid factor; TNFi: tumor necrosis factor inhibitor; VAS: visual analog scale.

long-term outcomes.[8-13,46] In addition, an analysis of JIA remission combining data from several clinical trials found that shorter time to biologic use after diagnosis was associated with a higher chance of remission.[47] Although we restricted our cohort to within 90 days of diagnosis, the marked differences in disease severity between the publicly and privately insured groups suggests that true disease duration at the time of diagnosis may differ. Differences in severity at initial presentation may have important implications for understanding variation in response to medications. Future work should address how timing of therapy initiation mediates racial and socioeconomic disparities in outcomes.

Limitations of this study include potential inconsistency in the recording of the prescribed start date of the TNFi vs the date when the first dose was administered. We were unable to assess reasons for the timing of TNFi initiation, including whether a child had a complete response to cDMARDs alone and whether longer time to escalation was a direct result of insurance coverage limitations. Although a strength of this study is the large, geographically diverse cohort, national trends may not be generalizable given state-based differences in plan coverage.[48] Finally, care at tertiary or quaternary pediatric rheumatology academic centers participating in the CARRA network represents an unknown fraction of JIA care, and this proportion may be lower among those with public insurance. In contrast to the 39.5% of children in the United States covered by Medicaid or other public plans, and the 5.6% of children in the United States who were uninsured in 2019,[49] our CARRA Registry cohort consisted of 25.5% publicly insured children and 1.3% uninsured children, with the remainder having private insurance. Parental education and household income were also higher than national averages. Although multisite validation of CARRA Registry insurance status showed high accuracy, it is possible that misclassification of insurance status in the study cohort may have affected our results. However, the majority of classification errors in our validation cohort involved a Medicaid

Downloaded on November 7, 2026 from www.jrheum.org

or other state insurance plan being classified as private, likely because of private insurance company names in the plan names of commercially managed Medicaid plans, rather than a private plan being recorded as public. As the privately insured group was much larger than the publicly insured group, this magnitude and direction of misclassification error is unlikely to substantially change our results. Finally, few children had changes in insurance status documented at 6- or 12-month visits; therefore, we relied on initial insurance status, which may understate barriers to timely medication initiation because of loss or change of insurance. Despite these limitations, our study has notable strengths, including the use of a large, multicenter, geographically diverse cohort; assessment of both overall medication use and timing of escalation; and adjustment for missing data and site-level practice differences.

In conclusion, our work demonstrated that although overall TNFi use did not differ between children with different insurance types, publicly insured children were escalated to TNFi more quickly, which may reflect increased disease severity in this group. There were significant differences in disease severity between publicly and privately insured children at the time of registry enrollment, even when restricting analysis to those with new diagnoses of JIA, which may reflect disparities in accessing pediatric rheumatology care. Future research should address the effects of more severe and long-standing disease at the time of presentation to rheumatology care on long-term arthritis outcomes, including medication effectiveness. Additional studies are needed to determine how insurance coverage type affects disease severity, including addressing the complex relationships between insurance coverage status and type and other demographic and socioeconomic factors that may present barriers to care.

ACKNOWLEDGMENT

We would like to thank Sarah Ringold and Tim Beukelman for their advice in designing this study. We also wish to acknowledge CARRA and the ongoing Arthritis Foundation financial support of CARRA. This work could not have been accomplished without the aid of the following organizations: the NIH's National Institute of Arthritis and Musculoskeletal and Skin Diseases and the Arthritis Foundation. We would also like to thank all participants and hospital sites that recruited patients for the CARRA Registry. The authors thank the following CARRA Registry site principal investigators, subinvestigators, and research coordinators: N. Abel, K. Abulaban, A. Adams, M. Adams, R. Agbayani, J. Aiello, S. Akoghlanian, C. Alejandro, E. Allenspach, R. Alperin, M. Alpizar, G. Amarilyo, W. Ambler, E. Anderson, S. Ardoin, S. Armendariz, E. Baker, I. Balboni, S. Balevic, L. Ballenger, S. Ballinger, N. Balmuri, F. Barbar-Smiley, L. Barillas-Arias, M. Basiaga, K. Baszis, M. Becker, H. Bell-Brunson, E. Beltz, H. Benham, S. Benseler, W. Bernal, T. Beukelman, T. Bigley, B. Binstadt, C. Black, M. Blakley, J. Bohnsack, J. Boland, A. Boneparth, S. Bowman, C. Bracaglia, E. Brooks, M. Brothers, A. Brown, H. Brunner, M. Buckley, M. Buckley, H. Bukulmez, D. Bullock, B. Cameron, S. Canna, L. Cannon, P. Carper, V. Cartwright, E. Cassidy, L. Cerracchio, E. Chalom, J. Chang, A. Chang-Hoftman, V. Chauhan, P. Chira, T. Chinn, K. Chundru, H. Clairman, D. Co, A. Confair, H. Conlon, R. Connor, A. Cooper, J. Cooper, S. Cooper, C. Correll, R. Corvalan, D. Costanzo, R. Cron, L. Curiel-Duran, T. Curington, M. Curry, A. Dalrymple, A. Davis, C. Davis, C. Davis, T. Davis, F. De Benedetti, D. De Ranieri, J. Dean, F. Dedeoglu, M. DeGuzman, N. Delnay, V. Dempsey, E. DeSantis, T. Dickson, J. Dingle, B. Donaldson, E. Dorsey, S. Dover, J. Dowling, J. Drew, K. Driest, Q. Du, K. Duarte, D. Durkee, E. Duverger, J. Dvergsten, A. Eberhard, M. Eckert, K. Ede, B. Edelheit, C. Edens, C. Edens, Y. Edgerly, M. Elder, B. Ervin, S. Fadrhonc, C. Failing, D. Fair, M. Falcon, L. Favier, S. Federici, B. Feldman, J. Fennell, I. Ferguson, P. Ferguson, B. Ferreira, R. Ferrucho, K. Fields, T. Finkel, M. Fitzgerald, C. Fleming, O. Flynn, L. Fogel, E. Fox, M. Fox, L. Franco, M. Freeman, K. Fritz, S. Froese, R. Fuhlbrigge, J. Fuller, N. George, K. Gerhold, D. Gerstbacher, M. Gilbert, M. Gillispie-Taylor, E. Giverc, C. Godiwala, I. Goh, H. Goheer, D. Goldsmith, E. Gotschlich, A. Gotte, B. Gottlieb, C. Gracia, T. Graham, S. Grevich, T. Griffin, J. Griswold, A. Grom, M. Guevara, P. Guittar, M. Guzman, M. Hager, T. Hahn, O. Halyabar, E. Hammelev, M. Hance, A. Hanson, L. Harel, S. Haro, J. Harris, O. Harry, E. Hartigan, J. Hausmann, A. Hay, K. Hayward, J. Heiart, K. Hekl, L. Henderson, M. Henrickson, A. Hersh, K. Hickey, P. Hill, S. Hillyer, L. Hiraki, M. Hiskey, P. Hobday, C. Hoffart, M. Holland, M. Hollander, S. Hong, M. Horwitz, J. Hsu, A. Huber, J. Huggins, J. Hui-Yuen, C. Hung, J. Huntington, A. Huttenlocher, M. Ibarra, L. Imundo, C. Inman, A. Insalaco, A. Jackson, S. Jackson, K. James, G. Janow, J. Jaquith, S. Jared, N. Johnson, J. Jones, J. Jones, J. Jones, K. Jones, S. Jones, S. Joshi, L. Jung, C. Justice, A. Justiniano, N. Karan, K. Kaufman, A. Kemp, E. Kessler, U. Khalsa, B. Kienzle, S. Kim, Y. Kimura, D. Kingsbury, M. Kitcharoensakkul, T. Klausmeier, K. Klein, M. Klein-Gitelman, B. Kompelien, A. Kosikowski, L. Kovalick, J. Kracker, S. Kramer, C. Kremer, J. Lai, J. Lam, B. Lang, S. Lapidus, B. Lapin, A. Lasky, D. Latham, E. Lawson, R. Laxer, P. Lee, P. Lee, T. Lee, L. Lentini, M. Lerman, D. Levy, S. Li, S. Lieberman, L. Lim, C. Lin, N. Ling, M. Lingis, M. Lo, D. Lovell, D. Lowman, N. Luca, S. Lvovich, C. Madison, J. Madison, S. Magni Manzoni, B. Malla, J. Maller, M. Malloy, M. Mannion, C. Manos, L. Marques, A. Martyniuk, T. Mason, S. Mathus, L. McAllister, K. McCarthy, K. McConnell, E. McCormick, D. McCurdy, P. McCurdy Stokes, S. McGuire, I. McHale, A. McMonagle, C. McMullen-Jackson, E. Meidan, E. Mellins, E. Mendoza, R. Mercado, A. Merritt, L. Michalowski, P. Miettunen, M. Miller, D. Milojevic, E. Mirizio, E. Misajon, M. Mitchell, R. Modica, S. Mohan, K. Moore, L. Moorthy, S. Morgan, E. Morgan Dewitt, C. Moss, T. Moussa, V. Mruk, A. Murphy, E. Muscal, R. Nadler, B. Nahal, K. Nanda, N. Nasah, L. Nassi, S. Nativ, M. Natter, J. Neely, B. Nelson, L. Newhall, L. Ng, J. Nicholas, R. Nicolai, P. Nigrovic, J. Nocton, B. Nolan, E. Oberle, B. Obispo, B. O'Brien, T. O'Brien, O. Okeke, M. Oliver, J. Olson, K. O'Neil, K. Onel, A. Orandi, M. Orlando, S. Osei-Onomah, R. Oz, E. Pagano, A. Paller, N. Pan, S. Panupattanapong, M. Pardeo, J. Paredes, A. Parsons, J. Patel, K. Pentakota, P. Pepmueller, T. Pfeiffer, K. Phillippi, D. Pires Marafon, K. Phillippi, L. Ponder, R. Pooni, S. Prahalad, S. Pratt, S. Protopapas, B. Puplava, J. Quach, M. Quinlan-Waters, C. Rabinovich, S. Radhakrishna, J. Rafko, J. Raisian, A. Rakestraw, C. Ramirez, E. Ramsay, S. Ramsey, R. Randell, A. Reed, H. Reid, K. Remmel, A. Repp, A. Reyes, A. Richmond, M. Riebschleger, S. Ringold, M. Riordan, M. Riskalla, M. Ritter, R. Rivas-Chacon, A. Robinson, E. Rodela, M. Rodriquez, K. Rojas, T. Ronis, M. Rosenkranz, B. Rosolowski, H. Rothermel, D. Rothman, E. Roth-Wojcicki, K. Rouster-Stevens, T. Rubinstein, N. Ruth, N. Saad, S. Sabbagh, E. Sacco, R. Sadun, C. Sandborg, A. Sanni, L. Santiago, A. Sarkissian, S. Savani, L. Scalzi, L. Schanberg, S. Scharnhorst, K. Schikler, A. Schlefman, H. Schmeling, K. Schmidt, E. Schmitt, R. Schneider, K. Schollaert-Fitch, G. Schulert, T. Seay, C. Seper, J. Shalen, R. Sheets, A. Shelly, S. Shenoi, K. Shergill, J. Shirley, M. Shishov, C. Shivers, E. Silverman, N. Singer, V. Sivaraman, J. Sletten, A. Smith, C. Smith, J. Smith, J. Smith, E. Smitherman, J. Soep, M. Son, S. Spence, L. Spiegel, J. Spitznagle, R. Sran, H. Srinivasalu, H. Stapp, K. Steigerwald, Y. Sterba Rakovchik, S. Stern, A. Stevens, B. Stevens, R. Stevenson, K. Stewart, C. Stingl, J. Stokes, M. Stoll, E. Stringer, S. Sule, J. Sumner, R. Sundel, M. Sutter, R. Syed, G. Syverson, A. Szymanski, S. Taber, R. Tal, A. Tambralli, A. Taneja, T. Tanner, S. Tapani, G. Tarshish, S. Tarvin, L. Tate, A. Taxter, J. Taylor, M. Terry, M. Tesher, A. Thatayatikom, B. Thomas, K. Tiffany, T. Ting, A. Tipp, D. Toib, K. Torok, C. Toruner, H. Tory, M. Toth, S. Tse, V. Tubwell, M. Twilt, S. Uriguen, T. Valcarcel, H. Van Mater, L. Vannoy, C. Varghese, N. Vasquez, K. Vazzana, R. Vehe, K. Veiga, J. Velez, J. Verbsky, G. Vilar, N. Volpe, E. von Scheven, S. Vora, J. Wagner,

Downloaded on November 7, 2026 from www.jrheum.org

L. Wagner-Weiner, D. Wahezi, H. Waite, J. Walker, H. Walters, T. Wampler Muskardin, L. Waqar, M. Waterfield, M. Watson, A. Watts, P. Weiser, J. Weiss, P. Weiss, E. Wershba, A. White, C. Williams, A. Wise, J. Woo, L. Woolnough, T. Wright, E. Wu, A. Yalcindag, M. Yee, E. Yen, R. Yeung, K. Yomogida, Q. Yu, R. Zapata, A. Zartoshti, A. Zeft, R. Zeft, Y. Zhang, Y. Zhao, A. Zhu, and C. Zic.

ONLINE SUPPLEMENT

Supplementary material accompanies the online version of this article.

REFERENCES

1. Brunner HI, Taylor J, Britto MT, et al. Differences in disease outcomes between Medicaid and privately insured children: possible health disparities in juvenile rheumatoid arthritis. Arthritis Rheum 2006;55:378-84.
2. Chang JC, Xiao R, Burnham JM, Weiss PF. Longitudinal assessment of racial disparities in juvenile idiopathic arthritis disease activity in a treat-to-target intervention. Pediatr Rheumatol Online J 2020;18:88.
3. Ringold S, Beukelman T, Nigrovic PA, Kimura Y, CARRA Registry Site Principal Investigators. Race, ethnicity, and disease outcomes in juvenile idiopathic arthritis: a cross-sectional analysis of the Childhood Arthritis and Rheumatology Research Alliance (CARRA) Registry. J Rheumatol 2013;40:936-42.
4. Soulsby WD, Balmuri N, Cooley V, et al. Social determinants of health influence disease activity and functional disability in polyarticular juvenile idiopathic arthritis. Pediatr Rheumatol Online J 2022;20:18.
5. Ringold S, Weiss PF, Colbert RA, et al. Childhood Arthritis and Rheumatology Research Alliance consensus treatment plans for new-onset polyarticular juvenile idiopathic arthritis. Arthritis Care Res 2014;66:1063-72.
6. Ringold S, Angeles-Han ST, Beukelman T, et al. 2019 American College of Rheumatology/Arthritis Foundation guideline for the treatment of juvenile idiopathic arthritis: therapeutic approaches for non-systemic polyarthritis, sacroiliitis, and enthesitis. Arthritis Care Res 2019;71:717-34.
7. Angeles-Han ST, Lo MS, Henderson LA, et al. Childhood Arthritis and Rheumatology Research Alliance consensus treatment plans for juvenile idiopathic arthritis-associated and idiopathic chronic anterior uveitis. Arthritis Care Res 2019;71:482-91.
8. Kljucevsek D, Emersic N, Toplak N, Avcin T. Clinical and MRI outcome of cervical spine lesions in children with juvenile idiopathic arthritis treated with anti-TNFα drugs early in disease course. Pediatr Rheumatol Online J 2017;15:38.
9. Billiau AD, Loop M, Le PQ, et al. Etanercept improves linear growth and bone mass acquisition in MTX-resistant polyarticular-course juvenile idiopathic arthritis. Rheumatology 2010;49:1550-8.
10. Wallace CA, Giannini EH, Spalding SJ, et al. Trial of early aggressive therapy in polyarticular juvenile idiopathic arthritis. Arthritis Rheum 2012;64:2012-21.
11. Blazina S, Markelj G, Avramovic MZ, Toplak N, Avcin T. Management of juvenile idiopathic arthritis: a clinical guide. Paediatr Drugs 2016;18:397-412.
12. Kimura Y, Schanberg LE, Tomlinson GA, et al. Optimizing the start time of biologics in polyarticular juvenile idiopathic arthritis: a comparative effectiveness study of Childhood Arthritis and Rheumatology Research Alliance consensus treatment plans. Arthritis Rheumatol 2021;73:1898-909.
13. Ong MS, Ringold S, Kimura Y, et al. Improved disease course associated with early initiation of biologics in polyarticular juvenile idiopathic arthritis: trajectory analysis of a Childhood Arthritis and Rheumatology Research Alliance consensus treatment plans study. Arthritis Rheumatol 2021;73:1910-20.
14. Zhao Y, Wallace C. Judicious use of biologicals in juvenile idiopathic arthritis. Curr Rheumatol Rep 2014;16:454.
15. Tynjala P, Vahasalo P, Tarkiainen M, et al. Aggressive combination drug therapy in very early polyarticular juvenile idiopathic arthritis (ACUTE-JIA): a multicentre randomised open-label clinical trial. Ann Rheum Dis 2011;70:1605-12.
16. Mannion ML, Xie F, Curtis JR, Beukelman T. Recent trends in medication usage for the treatment of juvenile idiopathic arthritis and the influence of tumor necrosis factor inhibitors. J Rheumatol 2014;41:2078-84.
17. Pohjankoski H, Kautiainen H, Lauri JV, Puolakka K, Rantalaiho V. Trends towards more active introduction of drug therapy, emphasizing methotrexate and biologic agents, for juvenile idiopathic arthritis. Clin Rheumatol. 2020 Jan;39:263-8. Erratum in: Clin Rheumatol 2020;39:299.
18. Suarez-Almazor ME, Berrios-Rivera JP, Cox V, Janssen NM, Marcus DM, Sessoms S. Initiation of disease-modifying antirheumatic drug therapy in minority and disadvantaged patients with rheumatoid arthritis. J Rheumatol 2007;34:2400-7.
19. Boytsov N, Zhang X, Evans KA, Johnson BH. Impact of plan-level access restrictions on effectiveness of biologics among patients with rheumatoid or psoriatic arthritis. Pharmacoecon Open 2020; 4:105-17.
20. Roberts JE, Fan M, Son MBF. Insurance delays in initiation of tumor necrosis factor inhibitors in children with juvenile idiopathic arthritis. JAMA Netw Open 2022;5:e228330.
21. Wallace ZS, Harkness T, Fu X, Stone JH, Choi HK, Walensky RP. Treatment delays associated with prior authorization for infusible medications: a cohort study. Arthritis Care Res 2020;72:1543-9.
22. Beukelman T, Kimura Y, Ilowite NT, et al. The new Childhood Arthritis and Rheumatology Research Alliance (CARRA) registry: design, rationale, and characteristics of patients enrolled in the first 12 months. Pediatr Rheumatol Online J 2017;15:30.
23. Shiff NJ, Beukelman T. Pharmacosurveillance in juvenile idiopathic arthritis. Rheum Dis Clin North Am 2021;47:643-53.
24. Fuhlbrigge RC, Schanberg LE, Kimura Y. CARRA: the Childhood Arthritis and Rheumatology Research Alliance. Rheum Dis Clin North Am 2021;47:531-43.
25. Swart JF, van Dijkhuizen EHP, Wulffraat NM, de Roock S. Clinical Juvenile Arthritis Disease Activity Score proves to be a useful tool in treat-to-target therapy in juvenile idiopathic arthritis. Ann Rheum Dis 2018;77:336-42.
26. Yu J, Perrin JM, Hagerman T, Houtrow AJ. Underinsurance among children in the United States. Pediatrics 2022;149:e2021050353.
27. Ong M, Schiff G, Natter M. Incidence, contributing factors, and impact of diagnostic delay in juvenile idiopathic arthritis: analysis of the Childhood Arthritis and Rheumatology Research Alliance (CARRA) Registry [abstract]. Arthritis Rheumatol 2020;72:109.
28. Balmuri N, Soulsby WD, Cooley V, et al. Community poverty level influences time to first pediatric rheumatology appointment in polyarticular juvenile idiopathic arthritis. Pediatr Rheumatol Online J 2021;19:122.
29. Chung EK, Siegel BS, Garg A, et al. Screening for social determinants of health among children and families living in poverty: a guide for clinicians. Curr Probl Pediatr Adolesc Health Care 2016;46:135-53.
30. Ludomirsky AB, Schpero WL, Wallace J, et al. In Medicaid managed care networks, care is highly concentrated among a small percentage of physicians. Health Aff 2022;41:760-8.
31. Grewal Y, Sofair A, Guevara M, Manthous CA. Medicaid patients' access to subspecialty care in Connecticut: teaching clinics questionnaire. Conn Med 2011;75:489-93.

Downloaded on November 7, 2026 from www.jrheum.org

32. Manthous CA, Sofair AN. On Medicaid and the Affordable Care Act in Connecticut: the problem with subspecialty services. Yale J Biol Med 2014;87:583-91.
33. McManus M, Fox H, Limb S, et al. New workforce, practice, and payment reforms essential for improving access to pediatric subspecialty care within the medical home. Arch Pediatr Adolesc Med 2009;163:200-2.
34. Ray KN, Kahn JM, Miller E, Mehrotra A. Use of adult-trained medical subspecialists by children seeking medical subspecialty care. J Pediatr 2016;176:173-81.e1.
35. Correll CK, Ditmyer MM, Mehta J, et al. 2015 American College of Rheumatology workforce study and demand projections of pediatric rheumatology workforce, 2015-2030. Arthritis Care Res 2022;74:340-8.
36. Riebschleger MP, Van Mater HA, Cohn LM, Clark SJ. Prescription patterns for children with juvenile idiopathic arthritis in Michigan Medicaid: a comparison by prescriber type. Pediatr Rheumatol Online J 2014;12:38.
37. Grimberg A, Feemster KA, Pati S, et al. Medically underserved girls receive less evaluation for short stature. Pediatrics 2011; 127:696-702.
38. Cabana M, Bruckman D, Rushton JL, Bratton SL, Green L. Receipt of asthma subspecialty care by children in a managed care organization. Ambul Pediatr 2002;2:456-61.
39. Perrin JM, Kenney GM, Rosenbaum S. Medicaid and child health equity. N Engl J Med 2020;383:2595-8.
40. Gilliam CA, Lindo EG, Cannon S, Kennedy L, Jewell TE, Tieder JS. Use of race in pediatric clinical practice guidelines: a systematic review. JAMA Pediatr 2022;176:804-10.
41. Amutah C, Greenidge K, Mante A, et al. Misrepresenting race - the role of medical schools in propagating physician bias. N Engl J Med 2021;384:872-8.
42. Singh DK, Magrey MN. Racial differences in clinical features and comorbidities in ankylosing spondylitis in the United States. J Rheumatol 2020;47:835-8.
43. Karmacharya P, Balls-Berry JE, Davis 3rd JM. True difference or detection bias: racial differences in clinical features and comorbidities in ankylosing spondylitis in the United States. J Rheumatol 2020;47:1150.
44. Fitzpatrick L, Broadaway KA, Ponder L, et al. Phenotypic characterization of juvenile idiopathic arthritis in African American children. J Rheumatol 2016;43:799-803.
45. Consolaro A, Ravelli A. Unraveling the phenotypic variability of juvenile idiopathic arthritis across races or geographic areas--key to understanding etiology and genetic factors? J Rheumatol 2016;43:683-5.
46. Minden K, Horneff G, Niewerth M, et al. Time of disease-modifying antirheumatic drug start in juvenile idiopathic arthritis and the likelihood of a drug-free remission in young adulthood. Arthritis Care Res 2019;71:471-81.
47. Lim LSH, Lokku A, Pullenayegum E, Ringold S. Probability of response in the first 16 weeks after starting biologics: an analysis of juvenile idiopathic arthritis biologics trials. Arthritis Care Res 2022 Aug 17 (Epub ahead of print).
48. Fischer MA, Polinski JM, Servi AD, Agnew-Blais J, Kaci L, Solomon DH. Prior authorization for biologic disease-modifying antirheumatic drugs: a description of US Medicaid programs. Arthritis Rheum 2008;59:1611-7.
49. Kaiser Family Foundation. Health insurance coverage of children 0-18. [Internet. Accessed May 31, 2022.] Available from: https://www.kff.org/other/state-indicator/children-0-18/

Downloaded on November 7, 2026 from www.jrheum.org