Do Patterns of Early Disease Severity Predict Grade 12 Academic Achievement in Youths with Childhood-onset Chronic Rheumatic Diseases?

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Abstract

Objectives: To test the association of early disease severity with grade 12 standards tests performance in individuals with childhood-onset chronic rheumatic diseases (ChildCRDs), including juvenile arthritis and systemic autoimmune rheumatic diseases.

Methods: We used linked provincial administrative data to identify ChildCRD patients born between 1979 and 1998 in Manitoba, Canada. Primary outcomes were Language and Arts achievement index (LAI) and Maths achievement index (MAI) scores from grade 12 standards tests results and enrollment data. A secondary outcome was enrollment in grade 12 by age 17 years. Latent class trajectory analysis identified disease severity groups using physician visits following diagnosis. Multivariable linear regression tested the association of disease severity groups with LAI and MAI scores, and logistic regression tested the association of disease severity with age-appropriate enrollment, after adjusting for sociodemographic factors and psychiatric morbidities.

Results: The study cohort included 541 patients (70.1% females). A 3-class trajectory model provided the best fit; it classified 9.7 % as severe, 54.5% as moderate and 35.8% as mild disease. After covariate adjustment, severe disease was associated with poorer LAI and MAI scores but not with age-appropriate enrollment.

Conclusions: Among ChildCRD patients, those with severe disease performed more poorly in grade 12 standards tests, independent of sociodemographic and psychiatric risk factors. Clinicians should work with educators and policymakers to advocate for supports to improve education outcomes of ChildCRD patients.

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Introduction

Of the childhood-onset chronic rheumatic diseases (ChildCRDs), juvenile arthritis (JA) is the most common, affecting 1 in 1000 Canadian children(1). Systemic autoimmune rheumatic diseases (SARDs) are multi-system diseases, comprising systemic lupus erythematosus (SLE), inflammatory myositis, systemic sclerosis and Sjogren's syndrome(2). SARDs affect approximately 1 in 4500 Canadian children(3).

ChildCRD patients experience many disruptions, due to the underlying disease, adverse effects from treatment, and need for outpatient visits and hospitalizations. These disruptions may adversely affect the education outcomes of children with ChildCRD, which could affect future employment opportunities and socioeconomic achievements(4). Few studies have focused on education outcomes in ChildCRD patients(5-12). Results have been conflicting, with some showing that ChildCRD patients perform better than or similar to siblings or study controls(7-12). However, those studies were limited by small sample sizes, lack of control patients or potentially biased controls (e.g. friend-controls) and failure to account for sociodemographic factors that can influence education outcomes(13, 14). Graduation rate or school attendance was the most common outcome. However, neither is a good measure of academic performance, which is associated with students' cognition and learning, and related to future employment (15). In one study, juvenile arthritis patients with better grades were more likely to achieve future managerial or professional type employment(4).

Recently we showed that youths with ChildCRD performed significantly worse than youths without ChildCRD as measured by their grade 12 standards tests and had lower odds of age-appropriate enrollment in grade 12(16). ChildCRD was associated with grade 12 standards tests performance independent of sociodemographic and psychiatric factors. However, not all

ChildCRD youths performed poorly in school. Being able to identify those at higher risk would help ensure that youths who most need support receive it. We hypothesized that *more severe disease* would be associated with worse grade 12 standards tests results.

There is no single disease severity construct in rheumatic diseases. Previous research developed disease-specific severity indices using medical records or insurance claims data(17-20). Generally, the severity construct reflects high disease activity and is associated with increased morbidity and/or mortality, therefore requiring aggressive treatment(20, 21). Those with more severe disease have increased healthcare utilization(18, 22, 23). Patients with different disease severity may have distinctive patterns of healthcare utilization. We envision these patterns of healthcare utilization as indicators of disease severity in multiple ChildCRDs. We aimed to test the association of disease severity with academic performance in ChildCRD youths, adjusted for sociodemographic and psychiatric morbidities.

Methods

Study design & data sources

This was a retrospective, population-based, longitudinal cohort study from Manitoba, a Canadian province with a population of approximately 1.3 million (2016 Statistics Canada census) and a system of universal healthcare(24). Between 1984 and 2015, one centre in Manitoba provided all the pediatric rheumatology care and maintained a comprehensive clinical registry. Using this registry, we identified children in birth cohorts from 1979 to 1998 and linked them via anonymized personal health identification numbers to population-based administrative data housed in the Population Research Data Repository (PRDR) at the Manitoba Centre for Health Policy (MCHP) for the period from 1979 to 2015(25). Virtually all Manitobans are eligible for universal health insurance.

Multiple health administrative databases were accessed within the PRDR. The Manitoba Health Insurance Registry provided dates of birth, dates of health coverage, and family codes linking a child to the biological mother. The Discharge Abstracts Database provided hospitalization dates and discharge diagnoses. The medical services database provided billing information from outpatient physician visits; the provider registry provided information to distinguish rheumatologists from non-rheumatologists. The PRDR contains the complete longitudinal healthcare history for each individual from the initiation of their health insurance coverage (from birth or immigration into Manitoba) until loss of coverage (death or emigration).

The PRDR also houses non-health related administrative data from other government departments and the census data. We obtained grade 12 enrollment information and marks from the Enrollment, Marks and Assessment database, income assistance information from the Employment and Income Assistance database and information about children in out-of-home care information from the Child and Family Services Information Services database.

This study was approved by the University of Manitoba Health Research Ethics Board (HS20191) and the Manitoba Health Information Privacy Committee of the Manitoba ministry of health (HIPC 2016/2017-37). Consent was waived by the research ethics board due to the long duration and large numbers of patients involved.

Study population

The study cohort was comprised of JA patients with chronic childhood onset (< 16 years old) arthritis diagnosed according to the standards at the time of diagnosis; some of the children in this cohort were diagnosed before the International League Against Rheumatism criteria of juvenile idiopathic arthritis was developed(26). JA was divided into disease subtypes: oligoarticular (<5 joints involved) and non-oligoarticular JAs (≥5 joints involved). SARDs

patients had one of four systemic autoimmune diseases and were diagnosed <17 years old (i.e. age of transfer to adult services in Manitoba)(2). The study period was from the date of diagnosis to the date of the standards tests.

Key predictor

We conceptualized disease severity as a latent (i.e., unobserved) construct, measured by the number of physician visits (22). This fits with the Andersen Model of Health Service Use, where after accounting for enabling (e.g. access) and predisposing factors (e.g. sex), need (due to disease severity) drives use (22). In our study cohort, we expected the majority of healthcare encounters to be related to ChildCRD; previous studies from Manitoba's data estimated the average number of major health conditions in children up to 18 years to be ≤0.3 (27). The number of physician visits have been used in development of rheumatoid arthritis and lupus severity indices, and as surrogate severity markers in chronic childhood illnesses (20, 23, 27). To create the disease severity measure, we divided follow-up time into 6-months intervals to reduce the likelihood of intervals with sparse numbers of events and summed the number of physician visits (both primary care and specialist visits) within each interval for each patient.

Covariates

Sociodemographic factors: We defined the following sociodemographic and disease-related covariates at diagnosis using administrative data: age, sex, disease duration (from date of diagnosis to date of the grade 12 tests), maternal age at first childbirth, children ever in out-of-home care, and receipt of income assistance. We also defined the socioeconomic factor index version 2 (SEFI2)(13, 14, 28-30), an area-based socioeconomic measure derived from several Statistics Canada census variables including: proportion of the population without high school graduation, proportion of single parent families, average household income and unemployment

rate. SEFI2 is constructed for dissemination areas (smallest geographic units for census data). The lower the SEFI2 value, the higher the socioeconomic status.

Psychiatric disorders: We identified six disorders: depression, anxiety, psychosis, attention deficit hyperactivity disorder, autistic spectrum disorder and substance use, using case definitions developed for Manitoba children using diagnoses in hospital and physician visits (31). An individual was considered to have a psychiatric disorder if they had one of the six disorders. Psychiatric disorders were identified as premorbid if they were diagnosed before the date of ChildCRD diagnosis, or intercurrent, if they were diagnosed in the 12 months leading up to the date of the first of the grade 12 standards tests.

Outcomes

The primary outcomes were a) Language Arts achievement index (LAI) scores and b) Maths achievement index (MAI) scores(32, 33). In grade 12, every Manitoba student undergoes two mandatory standards tests in the language arts and math . The LAI and MAI scores were derived from test scores and enrollment information. There are 19 categories each for the LAI and MAI. The first 14 categories were logit transformed from raw scores of the standards tests (32, 33). The last five (other) categories documented the remaining student population without scores as absent/dropped class, grade 12 but not tested, grade 11 or lower, not enrolled and withdrawn from school. With the logit transformation, mean LAI and MAI scores are approximately zero with standard deviations of one. LAI and MAI categories correlate with the probability of graduating from high school over four years(32). Given that the LAI and MAI are standardized, they can be interpreted using Cohen's d effect size, where 0.2 denote a small difference, 0.50 a medium difference and 0.8 a large difference(34).

The secondary outcome, age-appropriate enrollment, was defined as enrollment (yes or no) in grade 12 by age 17 years. This is an overall measure of school performance.

Statistical Analysis

Categorical variables were described using frequencies and percentages; continuous variables were described using means and standard deviations (SDs) or medians and interquartile ranges (25^{th}-75^{th} percentiles) as appropriate. Means were compared using t-tests and proportions were compared using chi-squared tests of independence.

Group-Based Trajectory Model (GBTM) to create the disease severity measure

We applied GBTM to the total number of physician visits in each 6-month interval for the first 3.5 years after diagnosis, to create the disease severity measure, DisSev(35). GBTM is a semi-parametric longitudinal statistical method that can be applied to a heterogeneous population to delineate distinct group-based trajectories of one or more outcomes. Individuals with the same outcome trajectory comprise a group. We limited to the timeframe to 3.5 years as it was the period of maximal variability in visits, with ≥80% of the population having this length of follow-up and frequent visits during this period. A cubic trend provided the best fit for DisSev trajectories using a model that assumed a zero inflated Poisson distribution. Model fit was assessed using the Bayesian information criterion (BIC), a penalized measure of the log likelihood function, because it tends to select more parsimonious models than the Akaike information criterion. We first fit a two-class model to the trajectory data, and then fit models with an increasing number of classes until the nadir of the BIC was achieved or when the smallest class included < 10% of the total population(36). The choice of best fit model was also guided by clinical experience (36, 37). The TRAJ procedure in SAS 9.4 was used for model fitting (SAS Institute, Cary, USA).

We tested disease subtype (oligoarticular JA, non-oligoarticular JA, SARD) as a predictor of membership in latent disease severity trajectories, creating DisSevS (for subtype). DisSevS was constructed using the model-fitting process as for DisSev, except that it included disease subtype as a membership covariate. The model fits of DisSev and DisSevS were compared using the BIC to select the better model of disease severity to use for subsequent multivariable modelling of LAI, MAI and age-appropriate enrollment.

Cohort members with a posterior probability ≥ 0.8 of belonging to a disease severity latent class were assigned to that class for subsequent multivariable modelling of grade 12 performance(37, 38). Those with posterior probability <0.8 were excluded from the subsequent analysis to ensure only those with clearly differentiated probabilities of belonging to one class were used in analysis(37, 39).

Predicting grade 12 standards tests performance

Univariable linear regression models were used to test associations between the LAI and MAI scores and disease severity groups, sociodemographic factors, and psychiatric comorbidities. Univariable logistic regression models were used to test association between age-appropriate enrollment and the same covariates as above (appendix Table A6). Subsequently, multivariable linear regression models were fit to the LAI and MAI scores that included disease severity groups, sociodemographic factors, and psychiatric comorbidities. A multivariable logistic regression model was fit to age-appropriate enrollment with the same covariates. Linear and logistic regression models were applied using the GENMOD procedure (SAS 9.4). Adjusted regression coefficients and their standard errors (SE) were reported for the multivariable linear regression models and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported for the multivariable logistic regression models. The scaled Pearson χ^2 was used to

assess model fit for the linear regression models and the c-statistic was used to assess discriminative performance for the logistic regression models.

Results

Population Characteristics

We included 541 patients (see Figure 1) with ChildCRDs: 497 JA and 44 SARDs (Table 1), most were females (70.1%). About half of the study population had more than 8 years of data from diagnosis to LAI or MAI scores and one-quarter had more than 13.5 years of data. Mean disease duration for the study population was 7.5 years (Appendix Table A2 for disease duration quintiles).

Outcomes

The mean (SD) LAI scores for the JA and SARD groups were -0.2 (1.0), and -0.2 (1.1) respectively. The mean (SD) MAI scores for the JA and SARD group were -0.2 (1.0) and -0.2 (1.1) respectively. The mean LAI and MAI scores did not differ significantly between the two groups. We compared the pass, fail and non-participation rates for the standards tests by disease severity group; none were significantly different (Figure 2). In addition, we compared the differences in test-taking rates across disease severity groups and did not find significant differences (Appendix Table A3).

Disease Severity

When DisSev and DisSevS models were compared using the BIC, fit was similar (Appendix Table A1). We therefore used DisSev, the most parsimonious model, in subsequent modelling. The best-fit model for DisSev had three latent trajectory classes. Class 1 (35.8%) was the mild disease group with the fewest visits, class 2 (54.5%) was the moderate disease group and class 3 (9.7%) was the severe disease group with the greatest numbers of visits (Figure 3). The mean

posterior probability of group membership was 0.96 (lower limit [LL] 0.51), 0.97 (LL 0.51), 0.98 (LL 0.67) for the three classes, respectively. Overall, 93.3% (505/541) of individuals were classified into one group using the criterion of posterior probability ≥ 0.8 (Appendix Table A4). Compared to oligoarticular JA patients (65.7%) and non-oligoarticular JA patients (61.3%), more SARD patients (76.2%) clustered in the moderate and severe disease groups (Appendix Table A5). SARD patients, when compared to oligoarticular or non-oligoarticular JA patients, had higher odds of belonging to the severe group than the mild or moderate groups (Table 2). Compared to oligoarticular JA patients, non-oligoarticular JA patients did not differ in their probability of belonging to a disease severity group (Table 2).

Univariable Models

Univariable models (Appendix Table A6) revealed that severe disease, worse SEFI2, younger maternal age at first childbirth, receipt of out-of-home care and income assistance, were associated with worse LAI and MAI scores. Male sex was associated with worse LAI scores but not worse MAI scores. Similar factors (except sex) were associated with a reduced odds of age-appropriate enrollment. Psychiatric morbidities were not associated with education outcomes.

Multivariable Models for LAI and MAI Scores

After covariate adjustment, worse LAI scores were predicted by severe disease as compared to mild disease, male sex, the lowest family socioeconomic status, having a mother who had her first child <25 years old and being a member of a family requiring income assistance (Table 3). Those with moderate disease performed better than those with severe disease (p=0.001, results not shown).

Worse MAI scores were predicted by severe disease as compared to mild disease, lower family socioeconomic status, having a mother who had her first child < 25 years old, being a child who

was ever in out-of-home care, or in a family receiving income assistance. Those with moderate disease had higher MAI scores compared to those with severe disease ($p<0.001$, results not shown). There was no significant difference in MAI performance between those with moderate and mild disease.

Multivariable Model for Age-Appropriate Enrollment

Age-appropriate enrollment was not associated with disease severity (Table 3). Those in the lowest socioeconomic group (vs highest), whose mother had a first child <20 years old (vs ≥ 25 years old), had ever been in out-of-home care or whose family received income assistance, were less likely to be enrolled in grade 12 at an appropriate age.

Discussion

We developed a disease severity indicator based on all physician outpatient visits and used it to predict grade 12 standards tests performance and age-appropriate grade 12 enrollment among ChildCRD youths. Differences in disease severity trajectories were discernible within 3.5 years from diagnosis. There were three latent classes of disease severity trajectories. Severe disease predicted worse language arts and maths performance but not age-appropriate enrollment in grade 12. Sociodemographic factors, including family socioeconomic status, maternal age at first childbirth, child ever in out-of-home care, and family receiving income assistance, had associations as large or larger than that of having severe ChildCRD.

We created a disease severity indicator health administrative data research, applicable to multiple ChildCRDs. The non-oligoarticular group did not cluster significantly differently from the oligoarticular group in the disease severity groups. This could be due to the use of baseline JA designations. About 50% of oligoarticular JA patients become extended oligoarticular arthritis over time, behaving more like polyarticular (i.e. like non-oligoarticular) patients(26). In

clinical practice, difficult oligoarticular patients with frequent flares or difficult to treat disease could also require more visits and DMARDs.

We chose LAI and MAI as they are more informative outcome measures than high school graduation or attendance. Most high school students would graduate, but the paths to graduation could be very different; students could take academically demanding or vocational type subjects. Academic performance is reflective of a complex underlying construct, including cognitive ability, school experience and learning (15, 40). ChildCRDs disrupt school to different degrees for individuals. Patients' test scores or reasons for non-participation, measured through the indices provided richer information than a binary graduation measure.

As expected, sociodemographic/economic factors strongly predicted education outcomes. The relationships between child health, parental socioeconomic status and later education and employment outcomes are complex, with many interactions among the measures and bidirectional effects. The socioeconomic associations identified in our study are consistent with the findings in economics and education literature, which showed parental socioeconomic factors intersected with child health and education outcomes(41). In studies from Canada, US and UK, children from lower income families had worse health, more health insults and were more limited by chronic illnesses, compared to those not from low-income families (27, 41-43). Even after controlling for parental education and income, individuals who had poor child health had significantly lower adult education, health and social status (41, 44). The association of childhood chronic illnesses with poorer grade 12 standards test results and young adult socioeconomic outcomes had also been demonstrated in another population study from Manitoba (27).

Education is human capital and considered an investment for future earnings, explaining a significant variance of adult incomes(41). Young adults with rheumatic diseases have challenges in establishing employment and experienced increased job insecurity (11, 45, 46). Employment not only has implications for socioeconomic achievements but could affect the health of chronically ill individuals through healthcare benefits access. Among young adults with rheumatic conditions, those with higher education and more mentally demanding work were better able to retain employment during the difficult economic conditions during the COVID19 pandemic(47). Therefore, identifying ChildCRD patients at risk of poor education outcomes and successfully intervening with supports could have far-reaching implications on their future employment, adult socioeconomic and health outcomes.

We aimed to predict future grade 12 academic performance so that we could identify children at risk early, to help them obtain timely supportive educational resources. Therefore, we focused only on factors that occurred in early disease course or within defined periods before the tests for us to strongly advocate for education support for patients with risk factors at those times. We did not use the entire disease course and therefore did not capture all possible flares. However, previous ChildCRD studies have shown that disease patterns were often established within the first 3 years after diagnosis, well within the period of time in which we developed our severity indicator (37, 48). We have presumed ChildCRD patients' healthcare utilizations were related to the underlying disease severity. We acknowledge that healthcare utilization is an imperfect measure of disease severity; other factors may also influence utilization, such as individual/parental health beliefs, psychological characteristics, mental health, social structure and ease of access to healthcare resources(22). Ethnicity is associated with education performance and attainment(49, 50). However, ethnicity information is not available in the

administrative data used for this study. We could not directly adjust for family and specific community contextual factors. However, the SEFI2 included items which could partially adjust for the community context.

In conclusion, ChildCRD youth with the most severe early disease had worse language arts and maths grade 12 standards tests results compared to those with mild disease, independent of sociodemographic and psychiatric morbidities. As sociodemographic factors have an effect that could be greater than the effect disease severity, a good understanding of the social risk factors of ChildCRD patients is important. By recognizing early disease severity patterns, high-risk sociodemographic and psychiatric predictors, pediatric rheumatologists could identify children at risk earlier and advocate for their educational support as early as possible to improve educational outcomes. Pediatric rheumatologists can play an important role to help our youths and families engage with their teachers, peers, school authorities, for better understanding and support of the youth with ChildCRD.

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Figure 1

JA, juvenile arthritis. SARD, systemic autoimmune rheumatic diseases. PRDR, Population Research Data Repository.

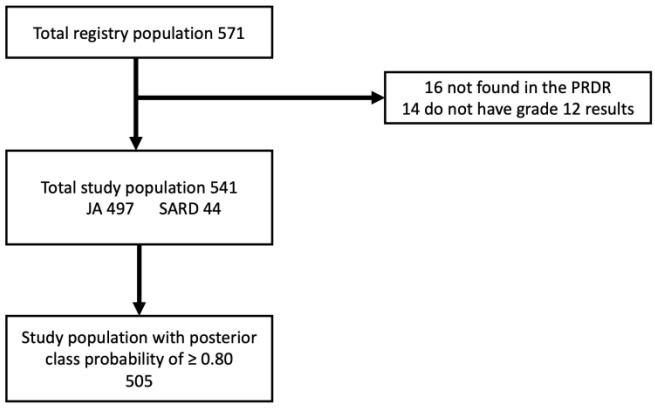
Figure 2

JA, juvenile arthritis. SARD, systemic autoimmune rheumatic diseases. LAI, language arts achievement index. MAI, maths achievement index. * Results suppressed due to low cell counts (<6) to comply with privacy and confidentiality requirements. Other, 5 categories of the LAI and MAI where standards tests not taken for various reasons (see methods).

Figure 3

No legend. Included within figure.

Figure 1: Derivation of Study Population



JA, juvenile arthritis. SARD, systemic autoimmune rheumatic diseases. PRDR, Population Research Data Repository.

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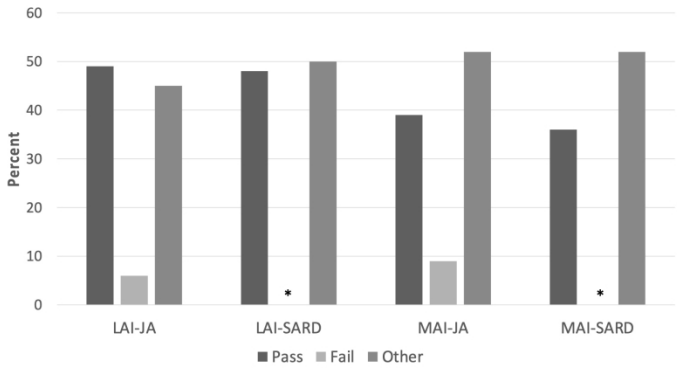
Table 1: Characteristics of ChildCRD study population

Characteristic	JA	SARD
	N=497	N=44
Females, n (%)	342 (68.8)	37 (84.1)
Disease duration, years[a]	7.5 (4.3– 13.6)	6.9 (2.6– 8.8)
Disease type, n (%)		
Oligoarticular JA	199 (40.0)	NA
Non-oligoarticular JA	298 (60.0)	NA
SLE	NA	23 (52.3)
Inflammatory myositis/ Sjogren syndrome/ systemic sclerosis	NA	21 (47.7)
SEFI2[b], n (%)		
<–1	102 (20.5)	8 (18.2)
–1≥ to <0	201 (40.4)	11 (25.0)
0≥ to < 1	125 (25.2)	15 (34.1)
≥ 1	69 (13.9)	10 (22.7)
Maternal age at first birth, years n (%)		
≤17	43 (8.7)	S*
18-19	63 (12.7)	S*
20-24	150 (30.2)	17 (38.6)
≥ 25	237 (47.7)	16 (36.4)
Received income assistance, n (%)	91 (18.3)	8 (18.2)
Out-of-home care, n (%)	25 (5.0)	S*

Premorbid psychiatric morbidity, n (%)	42 (8.5)	S*
Disease course psychiatric morbidity, n (%)	59 (11.9)	8 (18.2)
Intercurrent psychiatric morbidity, n (%)	26 (5.2)	S*

ChildCRD, childhood-onset chronic rheumatic disease. JA, juvenile arthritis. SARD, systemic autoimmune rheumatic diseases. SLE, systemic lupus erythematosus. S*, suppressed value due to small cell size (<6) in compliance with privacy and confidentiality requirements. [a]Median (25-75th percentile). [b]Negative socioeconomic factor index version 2 (SEFI2) scores indicate better socioeconomic status.

Figure 2: Language arts achievement (LAI) and maths achievement index (MAI) results by disease group



JA, juvenile arthritis. SARD, systemic autoimmune rheumatic diseases. LAI, language arts achievement index. MAI, maths achievement index. * Results suppressed due to low cell counts (<6) to comply with privacy and confidentiality requirements. Other, 5 categories of the LAI and MAI where standards tests not taken for various reasons (see methods).

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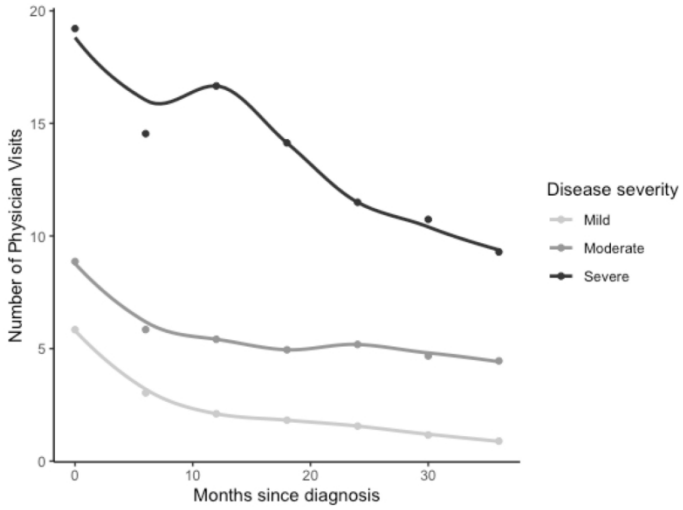
Figure 3: Disease severity group trajectories in childhood-onset chronic rheumatic diseases



None

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Table 2: Odds ratios (95% confidence intervals) for ChildCRD disease subtypes as predictors of disease severity for individuals whose highest posterior class probability was >0.80 (n=505).

Comparisons*	Class comparisons	OR (95% CI)^
SARD	severe (ref= mild)	**8.63 (3.15-23.65)**
(ref= oligoarticular)	moderate (ref= mild)	1.11 (0.49-2.53)
	severe (ref= moderate)	**7.76 (3.16-19.11)**
SARD	severe (ref= mild)	**7.70 (2.83-17.44)**
(ref= Non-oligoarticular)	moderate (ref= mild)	1.43 (0.64- 3.18)
	severe (ref= moderate)	**4.93 (2.22-10.94)**
Non-oligoarticular	severe (ref= mild)	1.23 (0.58-2.60)
(ref= oligoarticular)	moderate (ref= mild)	0.78 (0.53- 1.14)
	severe (ref= mild)	1.58 (0.76-3.27)

OR, odds ratio. CI, confidence intervals. *Oligoarticular and non-oligoarticular are juvenile arthritis subtypes. Systemic autoimmune rheumatic diseases, SARD. Ref refers to the comparison reference group. ^ Statistically significant results are reported in boldface font.

Table 3: Regression coefficient estimates (b) and standard errors (SE) for multivariable linear models of LAI and MAI scores, and odds ratios (OR) and 95% confidence intervals (CI) for age-appropriate grade 12 enrollment in ChildCRD patients (n=505 patients)

	LAI b (SE)	**MAI** b (SE)	**Age-Appropriate Enrollment** OR (95% CI)
Disease severity			
Severe	**–0.33 (0.16)**	**–0.42 (0.15)**	0.50 (0.23-1.08)
Moderate	0.15 (0.10)	0.12 (0.10)	1.55 (0.92-2.62)
Mild	Reference	Reference	Reference
Age at diagnosis	0.00 (0.04)	–0.02 (0.04)	1.02 (0.84-1.23)
Quintile of disease duration in years			
1 (shortest)	0.23 (0.49)	0.58 (0.49)	1.22 (0.09-16.28)
2	0.19 (0.41)	0.44 (0.41)	1.65 (0.19-14.23)
3	0.27 (0.33)	0.51 (0.33)	1.74 (0.31-9.66)
4	0.17 (0.18)	0.39 (0.18)	1.75 (0.69-4.43)
5 (longest)	Reference	Reference	Reference
Sex			
Male	**–0.29 (0.09)**	–0.09 (0.10)	0.79 (0.48-1.29)
Female	Reference	Reference	Reference
SEFI2			

≥ 1	**–0.54 (0.17)**	**–0.74 (0.17)**	**0.21 (0.09-0.50)**
0≥ to < 1	–0.18 (0.13)	–0.24 (0.13)	0.60 (0.29-1.27)
–1≥ to <0	–0.09 (0.12)	–0.24 (0.12)	0.76 (0.38-1.54)
<–1	Reference	Reference	Reference
Maternal age at first birth, years			
≤17	**–0.54 (0.18)**	**–0.48 (0.18)**	**0.25 (0.10-0.59)**
18-19	**–0.60 (0.15)**	**–0.55 (0.14)**	**0.25 (0.13-0.49)**
20-24	**–0.31 (0.10)**	**–0.22 (0.10)**	0.61 (0.36-1.05)
≥ 25	Reference	Reference	Reference
Out-of-home care	–0.38 (0.22)	**–0.45 (0.21)**	**0.09 (0.02-0.46)**
Income assistance	**–0.38 (0.13)**	**–0.37 (0.12)**	**0.36 (0.20-0.64)**
Premorbid psychiatric morbidity	–0.18 (0.16)	–0.30 (0.17)	0.59 (0.26-1.35)
Intercurrent psychiatric morbidity	–0.13 (0.19)	–0.001 (0.19)	1.17 (0.40-3.46)

Statistically significant results are reported in boldface font. ChildCRD, childhood-onset chronic rheumatic diseases. LAI, language arts achievement index. MAI, maths achievement index. SEFI2, socioeconomic factor index version 2.