Patients with rheumatic diseases share similar patterns of healthcare resource utilization

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Objectives: Healthcare service needs have changed with the use of effective treatment strategies. Using data from the modern era, we aimed to explore and compare health service-related direct costs in juvenile idiopathic arthritis (JIA), psoriatic arthritis (PsA), rheumatoid arthritis (RA), and axial spondyloarthritis (AxSpA).

Methods: We linked a longitudinal, population-based clinical data set from Finland’s largest non-university hospital’s rheumatology clinic with an administrative database on health service-related direct costs in 2014. We compared all-cause costs and costs of comorbidities between adult patients with JIA, PsA, RA, and AxSpA (including ankylosing spondylitis). We also characterized patients with high healthcare resource utilization.

Results: Cost distributions were similar between rheumatic diseases (p = 0.88). In adulthood, patients with JIA displayed a similar economic burden to much older patients with other inflammatory rheumatic diseases. A minority were high utilizers: among 119 patients with JIA, 15% utilized as much as the remaining 85%. For PsA (213 patients), RA (1086), and AxSpA (277), the high-utilization proportion was 10%. Both low and high utilizers showed rather low disease activity, but in high utilizers, the patient-reported outcomes were slightly worse, with the most distinct differences in pain levels. Of health service-related direct costs, index rheumatic diseases comprised only one-third (43.6% in JIA) and the majority were comorbidity costs.

Conclusions: Patients with JIA, PsA, RA, and AxSpA share similar patterns of healthcare resource utilization, with substantial comorbidity costs and a minority being high utilizers. Innovations in meeting these patients’ needs are warranted.
service-related direct costs. The clinical data are longitudinal and have multiple repeated measurements as of 2007, and the administrative data hold information on the fiscal year 2014. We aimed to compare both the all-cause costs and the costs of comorbidities in adult patients with JIA, PsA, RA, and axial spondyloarthritis (AxSpA; including AS), and explore patients with high healthcare resource utilization.

**Method**

**Clinical data**

Patients with inflammatory rheumatic diseases, living in four municipalities (population around 140 000) in the Jyväskylä Central Hospital (JCH) area, were identified from their structured digital database (GoTreatIT® Rheuma application, DiaGraphIT®) (24). GoTreatIT prospectively collects structured data as part of its medical records and it is used in several rheumatology clinics in Finland and other countries.

We identified all patients aged ≥18 years with JIA, PsA, RA, or AxSpA treated in JCH, diagnosed by rheumatologists before 2014. In that region, all patients requiring specialist treatment for rheumatic diseases are treated in JCH, and we therefore consider these data population based.

The clinical data were collected systematically on every visit to the rheumatology unit between May 2007 and 16 March 2016. Repeated measures of inflammatory markers and functional measures were available for individuals, of which we took a median to demonstrate the long-term average level for each individual, and to avoid the effect of aberrant values, such as high erythrocyte sedimentation rate (ESR, mm/h) and C-reactive protein (mg/L) due to infections. Other variables considered included the 28-joint Disease Activity Score with three variables [DAS28-3 (ESR)] for disease activity, the visual analogue scale (VAS, 0–100) for pain, the Health Assessment Questionnaire index (HAQ, 0–3) for disability, and age (on 1 January 2014). Individuals with median DAS28 less than 2.6 were considered to be in a low disease activity state for most of the time or in remission. Medication data are presented as for patients as ever- and never-users of conventional DMARDs, methotrexate, and bDMARDs.

**Healthcare resource utilization data**

Routinely recorded administrative data from the electronic medical records (EMR) system, available for fiscal year 2014, comprise all public healthcare contacts, including contacts from both primary and specialty care, as well as contacts from outpatient care, inpatient wards, and the emergency department. A contact is defined as one encounter per diagnosis, for instance an appointment, one inpatient episode, a telephone call, or paperwork that includes logging on to the EMR. Public healthcare contacts with all healthcare professionals (physicians, nurses, and rehabilitation workers) are covered, since Finland requires reporting of every single healthcare contact, including primary care visits.

We used a Finnish system similar to the diagnosis-related group (DRG) (25, 26), one suitable for both inpatient and outpatient care, to group contacts based on recorded diagnoses, using either the International Classification of Primary Care, Second Edition (ICPC-2) or International Classification of Diseases, 10th Revision (ICD-10). Our grouping tool classified the ICPC-2 and ICD-10 diagnoses into 40 categories. A tool owned by Finnish Consulting Group Ltd determined costs for these contacts (in euros, EUR) based on disease category, age, sex, healthcare unit and provider, and procedures. If several diagnoses are recorded for a contact, the cost is divided equally among these. For over a decade, this tool has been used for cost reports in multiple Finnish municipalities, covering the health service for over one million inhabitants.

Healthcare resource utilization is indicated by health service-related direct costs. To avoid underestimation of costs, we also included the costs of any contacts lacking diagnosis codes. With the grouping tool, these contacts acquire a similar cost to contacts with similar background characteristics. This tool has been trained using a large body of data from both the study area and other municipalities.

**Comorbidities**

For the 40 comorbidity groups, we created the following 13 larger entities: (1) cardiovascular diseases, (2) diabetes, (3) eye disorders, (4) gastrointestinal disorders, (5) healthy/pregnancy, (6) infections, (7) malignancies, (8) mental disorders, (9) neurological disorders, (10) other musculoskeletal disorders, (11) rheumatic diseases, (12) skin disorders, and (13) other.

The detailed composition of these groups is provided in the online Supplementary table S1.

**Statistical analysis**

Patients included in the study had at least one healthcare contact in 2014 (i.e. non-zero costs). Data are presented using descriptive statistics. Categorical variables were compared using the chi-squared test, and continuous, independent variables with one-way analysis of variance (ANOVA) or the Kruskal–Wallis test, whichever was appropriate. For subsequent post-hoc testing, we used Tukey’s honestly significant difference test when the assumption of homogeneity of variances was met. For variables in the clinical data, we report the percentage of unique patients missing data, and for healthcare utilization data, the percentage of healthcare contacts missing data.
Costs are presented as annual means and medians with interquartile ranges (IQRs). We used the Kruskal–Wallis test to compare costs between the four diseases. High healthcare utilizers were identified for each disease by selecting a quantile cut-off point, so that those above the cut-off accounted for as much cost as those below it. Because cost data are generally skewed, a binary definition of high and low utilizers was used. Thus, patients with costs at or below the cut-off point were defined as low utilizers.

For data handling and statistical analyses, we used R (version 3.2.4).

In Finland, register-based studies require no ethics approval or informed consent from patients. Every Finnish citizen has a unique personal identification number and the data sets were combined using these unique numbers. The register keeper (JCH) approved the study.

Results

Patients

The data set involved a population-based sample of 1695 patients with the following rheumatic diseases: 119 adult patients with JIA, 213 with PsA, 1086 with RA, and 277 with AxSpA (Table 1). Sex distributions differed among the diseases (p < 0.001), with female sex being more common in JIA and RA. All diseases differed in terms of age (p < 0.001, also in pairwise comparisons). Patients with JIA were, on average, the youngest, and patients with RA the oldest. In patients with RA, rheumatoid factor was positive for 62.0%, anti-citrullinated peptide antibody for 55.6%, and both for 51.2% (data missing for 5.3%).

Healthcare resource utilization

Despite being heterogeneous in terms of patient characteristics, the all-cause cost distributions were similar across the patient groups (p = 0.88 with the Kruskal–Wallis test) (Figure 1; density plot in Supplementary figure S1). The all-cause annual health service-related direct costs were as follows: JIA, mean 3631 EUR/patient/year (median 2164 EUR, IQR 565–4867 EUR); PsA, mean 3816 EUR (median 1477 EUR, IQR 637–4486 EUR); RA, mean 4681 EUR (median 1738 EUR, IQR 707–4922 EUR); and AxSpA, mean 3571 EUR (median 1382 EUR, IQR 545–4080 EUR).

Health service-related costs by healthcare unit, in proportion to all contacts, are shown in Supplementary figure S2. For all four diseases, the majority of costs were specialty care costs, with emphasis on outpatient services. The proportion of inpatient costs was highest for RA (42.9%, combining primary and specialty care inpatient care). The proportion of primary care costs was also highest for RA (26.1%, inpatient and outpatient primary care). For all four diseases, day hospital visits accounted for approximately 10% of all costs, and emergency department visits for around 5%.

Diagnostic codes were available for 79.6% of healthcare contacts for patients with JIA, for 77.2% with PsA, for 69.8% with RA, and for 79.8% with AxSpA. For all other administrative variables, data were available for 95.5–100.0%. Of the contacts with no diagnosis code, 70.6–76.5% were other than face-to-face encounters, and a majority were non-physician contacts; these contacts incur lower costs than do physician encounters or inpatient episodes.

Table 1. Patient characteristics.

|               | JIA      | PsA     | RA       | AxSpA    | Missing data (%) |
|---------------|----------|---------|----------|----------|------------------|
| Patients, n   | 119      | 213     | 1086     | 277      | 0                |
| Female, n (%) | 92 (77.3)| 93 (43.7)| 773 (71.2)| 109 (39.4)| 0                |
| Age (years)   | 32.4 ± 13.4| 53.0 ± 14.9| 62.8 ± 15.0| 44.9 ± 13.7| 0                |
| BMI (kg/m²)   | 24.7 ± 5.3 | 27.3 ± 4.8 | 26.4 ± 4.7 | 26.4 ± 4.6 | 2.0              |
| Pain (VAS 0–100)| 22.6 ± 19.5| 29.6 ± 22.6| 29.4 ± 22.2| 30.6 ± 22.4| 1.7              |
| HAQ index (0–3)| 0.4 ± 0.6 | 0.6 ± 0.6 | 0.6 ± 0.6 | 0.5 ± 0.5 | 2.2              |
| DAS28-3       | 1.9 ± 0.8 | 2.2 ± 0.9 | 2.3 ± 0.8 | 1.9 ± 0.8 | 11.9*            |
| Medication in adulthood | 0.4–7.9 |

Continuous variables are shown as group means of individual medians ± sd.
Missing data signifies the mean percentage of unique patients who are missing data.
*Mean across all diseases, due to 13.1% of missing data in individuals with PsA and 22.0% in AxSpA, as DAS28-3 is not always evaluated in these diseases.

JIA, juvenile idiopathic arthritis; PsA, psoriatic arthritis; RA, rheumatoid arthritis; AxSpA, axial spondyloarthritis; BMI, body mass index; VAS, visual analogue scale; HAQ, Health Assessment Questionnaire; DAS28-3, 28-joint Disease Activity Score with three variables; DMARDs, disease-modifying anti-rheumatic drugs; bDMARDs, biological disease-modifying anti-rheumatic drugs.
Comorbidities

Costs of comorbidities were in proportion to contacts with recorded diagnoses (Table 2). In PsA, RA, and AxSpA the index rheumatic disease accounted for 33.2%, 32.5%, and 31.9% of costs, respectively. In JIA, this proportion was somewhat higher, at 43.6%.

In all the diseases, a quarter of all patients had contacted the healthcare services because of infections during 2014, but the proportional cost of infections was only 1.9–6.2% (Table 2). Among the diseases, cardiovascular diseases were the most common (in 27.9%) and most costly (12.8%) for RA. As expected, eye disorders were most common in JIA (13.4% had visits in 2014, accounting for 3.1% of costs) and in AxSpA (15.2%, accounting for 2.5% of costs). A few patients with a severe mental illness resulted in mental disorders being the costliest comorbidity in JIA.

High healthcare resource utilizers

In adult patients with JIA, 15% utilized as much as did the other 85%. Corresponding figures were 10% and 90% for PsA, RA, and AxSpA. High healthcare resource utilizers were identified by selecting a quantile cut-off point for which those above it accounted for as much cost as those below it. For each individual, we considered the median of time-dependent clinical variables observed in adulthood. A comparison of characteristics in high- and low-utilization proportions is shown in Table 3, with the distributions plotted in Supplementary figures S3–S7. The direction of the effect was similar in all the diseases and those with high utilization presented with higher average HAQ, DAS28-3, and pain compared with low utilizers. However, for DAS28-3, the majority of individuals with low utilization and approximately half of the individuals with high utilization had individual medians below 2.6. This means that at least half of the time they showed levels of DAS28-3 less than 2.6. Moreover, high utilizers were also somewhat older than low utilizers.

Table 2. Proportion of annual costs and proportion of individuals with at least one healthcare contact in 2014 for rheumatic diseases and other disorders.

| JIA | % of costs | Unique patients (%) | % of costs | Unique patients (%) | % of costs | Unique patients (%) | % of costs | Unique patients (%) |
|-----|------------|---------------------|------------|---------------------|------------|---------------------|------------|---------------------|
| Cardiovascular diseases* | 1.6 | 17 (14.3) | 9.4 | 36 (16.9) | 12.8 | 303 (27.9) | 4.1 | 40 (14.4) |
| Diabetes | 0.4 | 5 (4.2) | 0.5 | 15 (7.0) | 0.8 | 85 (7.8) | 1.2 | 13 (4.7) |
| Eye disorders | 3.1 | 16 (13.4) | 1.6 | 16 (7.5) | 1.1 | 97 (8.9) | 2.5 | 42 (15.2) |
| Gastrointestinal disorders | 2.9 | 11 (9.2) | 2.7 | 22 (10.3) | 7.1 | 152 (14.0) | 4.4 | 37 (13.4) |
| Healthy/pregnancy | 7.8 | 69 (58.0) | 3.5 | 119 (55.9) | 3.7 | 666 (61.3) | 3.8 | 133 (48.0) |
| Infections | 2.1 | 27 (22.7) | 1.9 | 45 (21.1) | 6.2 | 272 (25.0) | 3.8 | 68 (24.5) |
| Malignancies | 0.3 | 2 (1.7) | 1.7 | 6 (2.8) | 7.5 | 65 (60.0) | 7.8 | 12 (4.3) |
| Mental disorders | 7.9 | 12 (10.1) | 5.4 | 20 (9.4) | 2.2 | 50 (4.6) | 3.9 | 22 (7.9) |
| Neurological disorders | 4.7 | 18 (15.1) | 2.5 | 23 (10.8) | 2.3 | 137 (12.6) | 4.3 | 28 (10.1) |
| Other musculoskeletal disorders | 8.7 | 38 (31.9) | 17.2 | 82 (38.5) | 13.5 | 504 (46.4) | 12.8 | 124 (44.8) |
| Rheumatic diseases | 43.6 | 76 (63.9) | 33.2 | 142 (66.7) | 32.5 | 768 (70.7) | 31.9 | 170 (61.4) |
| Skin disorders | 1.8 | 19 (16.0) | 13.7 | 95 (44.6) | 2.5 | 179 (16.5) | 2.9 | 38 (13.7) |
| Other† | 15.1 | 48 (40.3) | 6.7 | 74 (34.7) | 7.8 | 433 (39.9) | 16 | 93 (33.6) |

*Stroke is included in ‘Cardiovascular diseases’.
†Diseases and disorders not included in the other categories (contacts with recorded diagnoses).
JIA, juvenile idiopathic arthritis; PsA, psoriatic arthritis; RA, rheumatoid arthritis; AxSpA, axial spondyloarthritis.
Owing to the small number of high utilizers in all patient groups except for RA, only a few patients incurred the comorbidity costs in the high utilizers (Supplementary table S2). This makes detailed comparison unreliable. Still, a pertinent observation was that the proportional costs of comorbidities were much higher in high utilizers. In JIA, comorbidities accounted for 49.4% of the costs of low utilizers and for 63.1% of high utilizers. These proportions were, respectively, 56.8% and 76.9% in PsA, 56.0% and 78.2% in RA, and 57.6% and 78.5% in AxSpA (detailed results are given in Supplementary table S2).

Discussion

In this population-based, observational study, we compared healthcare resource utilization indicated by health service-related direct costs across four rheumatic diseases. Despite apparent heterogeneity in patient characteristics, cost distributions were similar. At a younger age, patients with JIA as adults accounted for an economic burden similar to that of older patients with other inflammatory rheumatic diseases, perhaps as a result of their long-standing disease.

To our knowledge, this is the first study to report, in such detail, the economic comorbidity burden in adult patients with JIA. Also across the other rheumatic diseases, few have extensively reported comorbidity-related costs, including conditions not directly associated with the index disease (23, 27, 28). Moreover, many comparison studies are from a different era of treatments or focus on different aspects of disease burden, and none includes JIA (14, 15, 29, 30).

A minority were high healthcare resource utilizers. In JIA, 15% utilized as much as the remaining 85%. For PsA, RA, and AxSpA, the high-utilization proportion was 10%. In previous studies on other chronic diseases and the general population, high utilization and costs were concentrated in 5–10% of patients (31–34), but variations may arise from multiple factors such as different definitions of high costs and different study populations.

High utilizers presented with higher levels of chronic pain, an important factor affecting healthcare expenditure (35). In JIA, the non-adjusted average level of pain in high compared to low utilizers was 1.8-fold, in PsA and RA 1.4-fold, and in AxSpA 1.3-fold higher. Pain in rheumatic diseases is multifactorial, with joint-related causes such as active inflammation and chronic joint destruction, but also with alterations in pain-regulation mechanisms (36).

In inflammatory rheumatic diseases, chronic pain should be targeted as effectively as possible, regardless of aetiology. A study on primary care patients found that in high utilizers, depression was highly prevalent (37). Depression and pain commonly co-occur and depressive patients frequently report only

### Table 3. Comparison of characteristics in low- and high-utilization patient groups.

| Disease       | JIA     | PsA     | RA     | AxSpA   |
|---------------|---------|---------|--------|---------|
| N             | 101     | 191     | 977    | 249     |
| Age (years)   | 31.6 ± 13.0 | 56.6 ± 15.7 | 62.0 ± 14.8 | 68.4 ± 15.6 |
| Female (%)    | 76.2%   | 42.9%   | 72.2%  | 40.2%   |
| BMI (kg/m²)   | 24.1 ± 4.7 | 27.2 ± 4.6 | 26.4 ± 4.7 | 26.2 ± 4.3 |
| Disease duration (years) | 22.1 ± 13.3 | 10.3 ± 8.1 | 14.2 ± 10.3 | 12.7 ± 10.8 |
| HAQ (0–3)     | 0.3 ± 0.5 | 0.2 ± 0.3 | 0.4 ± 0.6 | 0.4 ± 0.5 |
| DAS28-3       | 2.0 ± 0.7 | 2.1 ± 0.9 | 2.2 ± 0.9 | 2.2 ± 1.0 |
| ESR (mm/h)    | 8.5 ± 6.9 | 17.1 ± 11.8 | 17.9 ± 13.6 | 17.9 ± 13.6 |
| Pain (VAS 0–100) | 20.0 ± 18.1 | 28.5 ± 22.2 | 28.9 ± 21.8 | 28.1 ± 21.8 |
| Erosions      | 11.9%   | 22.0%   | 44.0%  | 3.6%    |
| Ever bDMARDs  | 36.6%   | 42.0%   | 54.5%  | 39.0%   |

Continuous variables are shown as group means of individual medians ± sd. JIA, juvenile idiopathic arthritis; PsA, psoriatic arthritis; RA, rheumatoid arthritis; AxSpA, axial spondyloarthritis; BMI, body mass index; HAQ, Health Assessment Questionnaire; DAS28-3, 28-joint Disease Activity Score with three variables; ESR, erythrocyte sedimentation rate; VAS, visual analogue scale; bDMARDs, biological disease-modifying anti-rheumatic drugs.

Significant differences between groups: *p < 0.05, **p < 0.01, ***p < 0.001.
somatic complaints, a majority of which are pain related (38).

In addition to markedly higher pain, high utilizers presented with somewhat worse levels of other patient-reported outcome measures. Some of these differences, particularly higher HAQ scores, may reflect age differences. However, the average level of disease activity was rather low in both low and high utilizers, and the majority had individual medians of DAS28-3 below 2.6. This may indicate that the majority of patients have responded to treatment, as we would otherwise see much higher individual medians. Still, given the higher proportion of bDMARD ever-users and slightly higher levels of DAS28-3, high utilizers may have a history of more inflammation.

Another key difference was that in high utilizers proportional costs of comorbidities were considerably higher. Looking at all patients, only about one-third of costs (43.6% for JIA) were due to rheumatic diseases. For high utilizers only, this proportion was even lower, and costs of the index rheumatic disease comprised less than one-quarter. We may hypothesize that a more active inflammatory disease contributes to a higher and costlier comorbidity burden.

In low utilizers as well, the majority of costs were caused by conditions other than the rheumatic diseases. Overall, the rheumatic diseases seem to share a similar comorbidity burden. The most prevalent comorbidities, such as non-rheumatic musculoskeletal disorders, cardiovascular diseases, and infections, are also common conditions in the general population. Malignancies were rare in JIA and PsA, perhaps because of these patients’ youth; figures for RA and AxSpA were similar, although RA patients were older.

A review comparing the costs of RA (mean age 57 years) and younger patients with AS (mean age 47 years) reported higher direct costs for RA, but that study investigated mainly index disease-related costs (39). Another study on patients of working age with AS, RA, PsA, and systemic lupus erythematosus found them to have similar direct costs (15). A detailed comparison with previous studies is inconvenient because of different healthcare systems and study designs.

The main strength of this study is the integration of two data sources, one with rheumatologist and patient-reported data, and the second with data capturing all public healthcare contacts. We aimed to explore only health service-related direct costs, as our data are limited to these costs. Differences between rheumatic diseases are likely to exist for indirect costs and costs of medications, both of which are important components of the economic burden. A main limitation is that the utilization data are limited to 2014. In the region involved, a small private healthcare sector exists, mainly covering occupational care and private insurance holders, but we assume that it underestimates only comorbidity costs, because the rheumatic diseases were treated in the public healthcare sector. No formal definition of high utilization exists and the definition is always arbitrary. In addition, comparable longitudinal data on the prevalence of fibromyalgia were unavailable. Although missing diagnoses may affect the results, the volume of missing data was low and similar in all diseases.

We did not aim to compare either indirect costs or the costs of medication. However, some costs of bDMARDs administered in the day hospital were included. For the studied diseases, indirect costs and medication costs make up a large proportion of total costs (2, 40–43) and bDMARDs represent the main source of direct costs (2). The evolution of cost structures has been studied particularly for RA, showing an increase in medication costs, which, however, is considerably offset by a decrease in hospitalization costs and indirect costs (4, 44, 45), although work disability remains high (46).

Conclusion

Patients with JIA, PsA, RA, and AxSpA share similar patterns of healthcare resource utilization. However, in diseases with early age of onset, such as JIA and AxSpA, lifetime health service-related direct costs may be high because these patients display utilization patterns at a young age similar to those of much older patients with RA. The majority of all health service-related direct costs were comorbidity costs; the cost of rheumatic diseases comprised only one-third, with a somewhat higher proportion for JIA. Both low and high utilizers showed rather low levels of disease activity, but in high utilizers the patient-reported outcomes were slightly worse, with the most distinct differences being in pain levels. To reduce the economic burden of inflammatory rheumatic diseases, chronic pain should thus be targeted and disease activity should be lessened, which could also reduce the comorbidity burden.

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Disclosure statement

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Supporting Information

Additional Supporting Information may be found in the online version of this article.

Supplementary table S1. Detailed compositions of the comorbidity categories. Because all patients were adults, only these 38 of the 40 original categories were relevant as two categories are applicable only in children.

Supplementary table S2. Proportion of annual costs (EUR) for rheumatic diseases and other disorders, a comparison between high- and low-utilization groups. Due to the small number of high utilizers in all but RA, only a few patients produce the comorbidity costs in high utilizers.

Supplementary figure S1. Density plot on annual health service-related direct costs.

Supplementary figure S2. Annual direct all-cause healthcare costs by healthcare unit (proportions, %).

Supplementary figure S3. Distribution of age for high- and low-utilization groups.

Supplementary figure S4. Distribution of individual medians of DAS28-3 for high- and low-utilization groups.

Supplementary figure S5. Distribution of individual medians of pain for high- and low-utilization groups.

Supplementary figure S6. Distribution of individual medians of HAQ index for high- and low-utilization groups.

Supplementary figure S7. Distribution of individual medians of fatigue for high- and low-utilization groups.

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