RHEUMATOLOGY

Rheumatology 2021;60:140–146
doi:10.1093/rheumatology/keaa237
Advance Access publication 27 June 2020

Concise report

Inflammatory hallmarks of lesser prominence in psoriatic arthritis patients starting biologics: a Nordic population-based cohort study

Rebekka Lund Hansen[1], Tanja Schoedt Jørgensen[1], Lene Dreyer[1,2], Merete L. Hetland[3,4], Bente Glintborg[3,4], Johan Askling[5], Daniela Di Giuseppe [5], Lennart T. H. Jacobsson[6], Johan K. Wallman [7], Dan Nordstrom[8], Kalle Aaltonen[9], Eirik K. Kristianslund[10], Tore K. Kvien[10], Sella A. Provan [10], Bjorn Gudbjornsson[11], Thorvadur J. Love[12], and L. E. Kristensen[1]

Abstract

Objectives. To assess secular trends in baseline characteristics of PsA patients initiating their first or subsequent biologic DMARD (bDMARD) therapy and to explore prescription patterns and treatment rates of bDMARDs from 2006 to 2017 in the Nordic countries.

Methods. PsA patients registered in the Nordic rheumatology registries initiating any treatment with bDMARDs were identified. The bDMARDs were grouped as original TNF inhibitor [TNFi; adalimumab (ADA), etanercept (ETN) and infliximab (IFX)]; certolizumab pegol (CZP) and golimumab (GOL); biosimilars and ustekinumab, based on the date of release. Baseline characteristics were compared for the five countries, supplemented by secular trends with R^2 calculations and point prevalence of bDMARD treatment.

Results. A total of 18 089 patients were identified (Denmark, 4361; Iceland, 449; Norway, 1948; Finland, 1069; Sweden, 10 262). A total of 54% of the patients were female, 34.3% of patients initiated an original TNFi, 8% CZP and GOL, 7.5% biosimilars and 0.3% ustekinumab as a first-line bDMARD. Subsequent bDMARDs were 25.2% original TNFi, 9% CZP and GOL, 12% biosimilars and 2.1% ustekinumab. From 2015 through 2017 there was a rapid uptake of biosimilars. The total of first-line bDMARD initiators with lower disease activity increased from 2006 to 2017, where an R^2 close to 1 showed a strong association.

Conclusion. Across the Nordic countries, the number of prescribed bDMARDs increased from 2006 to 2017, indicating a previously unmet need for bDMARDs in the PsA population. In recent years, PsA patients have initiated bDMARDs with lower disease activity compared with previous years, suggesting that bDMARDs are initiated in patients with a less active inflammatory phenotype.

Key words: psoriatic arthritis, bDMARDs, prescription patterns, international collaborations, secular trends of inflammatory hallmarks

CLINICAL SCIENCE

[1]Parker Institute, Copenhagen University Hospital, Bispebjerg and Frederiksberg, Copenhagen, [2]Department of Rheumatology, Aalborg University Hospital, Aalborg, [3]DANBIO and Copenhagen Center for Arthritis Research (COPECARE), Center for Rheumatology and Spine Diseases, Centre of Head and Orthopedics, Rigshospitalet, [4]Department of Clinical Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark, [5]Clinical Epidemiology Division, Department of Medicine Solna, Karolinska Institutet, Stockholm, [6]Department of Rheumatology & Inflammation Research, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, [7]Department of Clinical Sciences Lund, Rheumatology, Lund University, Skane University Hospital, Lund, Sweden, [8]ROB-FIN, Division of Medicine, Helsinki University Hospital and Helsinki University, [9]Pharmaceuticals Pricing Board, Ministry of Social Affairs and Health, Helsinki, Finland, [10]Department of Rheumatology, Diakonhjemmet Hospital, Oslo, Norway, [11]Centre for Rheumatology Research (ICEBIO), University Hospital, Faculty of Medicine, University of Iceland and [12]University of Iceland and Landspitali University Hospital, Reykjavik, Iceland

Submitted 27 February 2020; accepted: 8 April 2020

Correspondence to: Rebekka Lund Hansen, Copenhagen University, Parker Institute, Frederiksberg Hospital, Nordre Fasanvej 57, 2000 Frederiksberg, Denmark. E-mail: rebekka.lund.hansen@regionh.dk

Rheumatology key messages

- There has been an increased use of biologic therapies in the PsA population across the Nordic countries.
- PsA patients selected for bDMARD therapy demonstrate less inflammatory activity when initiating first-line biologic therapies.
- From 2015 through 2017 there was a rapid uptake of biosimilars in the Nordic countries

Introduction

PsA is a chronic systemic inflammatory disorder with not only arthritis of peripheral joints and the axial skeleton, but also dactylitis, enthesitis and skin and nail psoriasis. It has an adverse impact on physical function and quality of life and implications for the selection of treatment strategy [1, 2]. Recent studies in PsA demonstrate that the impact of the disease on quality of life is related to pain, skin involvement, functional disability and fatigue, as well as emotional and social aspects of the disease [3–9].

PsA can be effectively treated with DMARDs, including biologic DMARDs (bDMARDs) such as TNF inhibitors (TNFis) [1]. TNFis are recommended as treatment for PsA, with comprehensive evidence that they decrease disease activity and slow radiographic progression [10]. Ustekinumab, a monoclonal anti-IL-12/23p40 antibody, and secukinumab, an anti-IL-17 antibody, have also been approved for the treatment of PsA and plaque psoriasis [1]. Clinical trials for PsA of TNFis and ustekinumab have demonstrated that both PsA and psoriasis improve in evaluable study populations [11].

The heterogeneity of the disease requires assessment of multiple PsA domains to identify appropriate treatments for individual patients, which presents a challenge to the treating physician and in this context the importance of further investigation into the prescription [12–15].

Pharmacological management of PsA is an area that has witnessed an important expansion [16]. Data from observational registries are acknowledged as an important resource for documentation of treatment effects, supplementing randomized controlled trials [17]. The observational registries supply prospective data that can be used to explore prescription patterns, treatment rates and baseline characteristics. The five Nordic countries (Denmark, Iceland, Norway, Finland and Sweden) have all established such observational registries, including disease-related data of PsA patients. These real-life data allow for the investigation of long-term drug effects among a heterogeneous group of patients, in contrast to randomized clinical trials, which often include a limited number of patients who fulfil a strict set of inclusion criteria and are studied for a limited time span [18, 19].

The cooperation between the five Nordic countries and their data registries provides the opportunity to analyse and interpret a larger patient population than one individual country [20]. This cooperation allows for investigation of newly introduced treatments, such as biosimilars and ustekinumab. It also provides the opportunity to explore baseline disease activity patterns and whether there are differences between countries.

The main objective of this study was to describe the trends and changes in baseline characteristics over calendar time, including disease activity scores of PsA patients initiating their first-line of biologic therapy. Moreover, we aimed to explore the prescription patterns and choice of bDMARDs from 2006 to 2017 in PsA patients. This included similarities and differences between the countries' PsA patients who commenced their first-line bDMARD, using data from the Nordic rheumatology registries.

Methods

Study design, setting and participants

The study was designed as a population-based cohort study, including data on patients with PsA registered in the Nordic rheumatology registries: DANBIO (Denmark), ICEBIO (Iceland), NOR-DMARD (Norway), ROB-FIN (Finland) and SRQ (Sweden). PsA patients initiating treatment from 2006 to 2017 with bDMARDs as a first (bio-naïve patients) or subsequent biologic therapy were identified and included in the study.

The study was based on a predefined protocol available at http://www.parkerinst.dk/ongoing-projects/prescription-patterns-tumor-necrosis-factor-inhibitor-and-ustekinumab-psoriatic.

Treatments during the study period were identified and the bDMARDs were grouped as original TNFis [adalimumab (ADA), etanercept (ETN) and infliximab (IFX)], certolizumab pegol (CZP) and golimumab (GOL), biosimilars and ustekinumab, based on release date.

Treatments with anti-IL-17 were excluded, as they were not yet fully implemented in the Nordic countries during the study period.

Treatment decisions were made by the treating rheumatologists in accordance with national guidelines.

Variables and outcomes

For each patient, data at the start of the first as well as any subsequent treatment courses with the assessed biologic therapies were collected from the rheumatology registries, as were data on age, sex, disease duration, CRP, HAQ score, swollen joint count (SJC), tender joint count (TJC) and patient's visual analogue scale (VAS) for pain.

National prescription guidelines

Guidelines regarding the choice of first-line bDMARDs and prescription patterns varied by country. In Denmark, the Danish Society of Rheumatology and the Danish Society of Radiology have published guidelines for PsA treatment [17]. In Iceland, Icelandic Health Insurance (state insurance company) recommends the prescriptions of bDMARDs for PsA patients [17]. In Norway, the Drug Procurement Cooperation (since 2009) has published guidelines on first-line treatments [17]. In Sweden, the Swedish Society for Rheumatology publishes yearly updated guidelines for PsA treatment [17]. In Finland, no official guidelines exist, but bDMARDs are currently reimbursed for patients with active PsA with insufficient response or intolerance to conventional synthetic DMARDs (csDMARDs) [17, 21]. National guidelines for the Nordic countries generally harmonize with the EULAR guidelines and have been updated regularly, in line with updates to the EULAR guidelines.

Statistical analysis

The data were pooled for analyses. The means and S.D.s were calculated for age (in years), CRP, HAQ score, patient's VAS for pain, SJC and TJC and the percentage of females was calculated (Table 1). A simple conversion from the modified HAQ to HAQ scores was done for Norway to unify the data.

Descriptive statistics for prescription patterns of bDMARD therapy (Supplementary Fig. S1, available at *Rheumatology* online) were calculated for each country and for each year, subdivided by the first or subsequent bDMARD treatment, and were collectively plotted as a percentage per year and subdivided by original TNFi, CZP and GOL, biosimilars and ustekinumab. In the assessment of the relative use of each bDMARD type, for each country, the numerator was the number of patients in the biologic registry treated with each subdivided group of bDMARDs treatment per year, whereas the denominator was the total number of patients in the biologic registry per year.

The point prevalence of ongoing bDMARD treatment was calculated for each country per year and per 100 000 people [22–26] and presented in a table. The numerator was the number of patients with ongoing bDMARD treatment per year and per country and the denominator was the total population for each country per year and per 100 000 people. Due to low coverage data in Finland from 2011 to 2017, the point prevalence calculations were omitted for that time period. For Norway, an exception to this calculation was necessary because of their regional coverage. Here instead, the denominator was the total coverage population for the biologic registry for a given year.

Secular trends were plotted using the baseline characteristics for each country per year of parameters: CRP, disease duration, HAQ score, patient's VAS for pain, SJC and TJC. A trend line was computed and an R^2 close to 1 was interpreted as a strong association between the baseline characteristics of each country.

Data analysis was performed in SPSS (version 25; IBM, Armonk, NY, USA) and Excel (Microsoft, Redmond, WA, USA).

The study was conducted in accordance with the bioethics committees and data protection committees of the respective countries. Written informed consent from patients was not required according to national registration, except for Norway, where this was collected.

Results

A total of 18 089 treatment initiations were identified (DANBIO, 4361; ICEBIO, 449; NOR-DMARD, 1948; ROB-FIN, 1069; SRQ, 10 262). As first-line bDMARDs, 6198 (34.3%) patients initiated ADA, ETN and IFX; 1447 (8%) CZP and GOL; 1353 (7.5%) biosimilars (ETN and IFX) and 52 (0.3%) ustekinumab. Initiations of second or subsequent bDMARDs were 4560 (25.2%), 1630 (9%), 2176 (12%) and 376 (2.1%) patients, respectively. Ustekinumab was primarily used as a second or subsequent bDMARD. A total of 53.7% of the patients were female. All five countries showed trends of decreasing baseline CRP, SJC and TJC values over time from 2006 to 2017. Other parameters showed only slight or no association.

Table 1 Baseline characteristics in PsA patients starting their first bDMARD from 2006 to 2017 stratified by country

Characteristics	Denmark	Iceland	Norway	Sweden	Finland
Patients in registry, *n*	2004	221	913	5357	555
Age, years	47.6 (14.0)	50.1 (12.7)	48.3 (12.3)	48.4 (12.8)	47.7 (11.7)
Females, *n* (%)	2546 (58.4)	272 (60.6)	847 (43.5)	5509 (56.6)	537 (53.4)
Current smoking, *n* (%)	825 (18.9)	61 (13.6)	289 (18.8)	539 (13.1)	51 (18.4)
Disease duration, years	8.4 (9.8)	8.6 (7.0)	6.0 (7.9)	10.2 (9.4)	8.6 (8.3)
CRP, mg/L	7.0 (12.8)	5.3 (8.6)	10.3 (14.8)	12.6 (20.1)	11.4 (15.6)
HAQ score (0–3)	0.9 (0.7)	1.0 (0.7)	1.2 (2.0)	0.9 (0.6)	0.9 (0.6)
VAS for pain (0–100 mm)	44.3 (28.0)	45.9 (27.8)	46.8 (23.1)	57.5 (22.9)	53.8 (24.5)
SJC (0–28)	1.0 (2.1)	1.7 (2.5)	2.4 (3.3)	3.8 (4.1)	2.3 (3.4)
TJC (0–28)	3.4 (5.4)	2.4 (3.6)	4.5 (5.1)	6.1 (5.8)	2.4 (3.8)

Data are presented as mean (S.D.) unless stated otherwise. HAQ: Health assessment questionnaire, VAS: Visual analogue scale, CRP: C-reactive protein.

Baseline characteristics

At the initiation of the first biologic treatment, the mean age of all five Nordic countries was similar, with very little variation, ranging from 47.6 to 50.1 years of age. The percentage of females ranged from 43.5 to 58.4% and the percentage of currently smoking patients ranged from 13.1 to 18.9% (Table 1).

The HAQ score and SJC exhibited similar distributions with minor differences across the five Nordic countries. The mean HAQ score ranged from 0.9 to 1.2 and was highest in Norway (1.2) followed by Iceland (1.0), Sweden (0.9), Denmark (0.9) and Finland (0.9).

Sweden displayed numerically higher mean values for patient's VAS for pain (57.5), SJC (3.8) and TJC (6.1) than the remaining four countries, which exhibited more similar means (patient's VAS for pain, 44.3–57.5; SJC, 1.0–2.4; TCJ, 2.4–4.5), with Denmark having the lowest scores in VAS for pain and SJC.

For the CRP values, both Iceland (5.3) and Denmark (7.0) had much lower mean values compared with Norway (10.3), Sweden (12.8) and Finland (11.4).

Drug prescription patterns

The choice of first-line bDMARD varied among the countries and over time. After 2014 there was a decline in all countries of original bDMARD use, while the use of biosimilars increased. This was most marked in Denmark, Sweden and Iceland, while Finland and Norway had a less drastic increase (Supplementary Fig. S1, available at *Rheumatology* online).

From 2006 to 2017, many changes in the prescription patterns of both first and subsequent bDMARDs were noticeable in all five countries. Some countries show more similarities than others, but for all the Nordic countries it is evident that they all started prescribing GOL and CZP in 2009 and biosimilars in 2014. Denmark, Iceland and Sweden seemed to follow the same development of switching from primarily prescribing original TNFis in 2014 to biosimilars when they became available for clinical use. Norway also showed the same pattern of change in prescription practice to biosimilar prescriptions, with an abrupt decrease in prescriptions of original TNFis in 2013–2014 and an uptake of biosimilar prescriptions earlier than Sweden and Denmark. The increase in uptake of biosimilars was greatest for Iceland, followed by Denmark, with Sweden and Norway lower overall but seemingly similar in the uptake increase. Finland has had a predominant use of original TNFis, which continued across time, with the addition of GOL and CZP in 2009 as they became available. For Finland, none of the new therapies seem to have been able to replace the first-choice prescription of original TNFis. The use of ustekinumab was minimal for all five countries, where Finland seemed to be the country with the most prescriptions, topping in 2015.

Prescription rates over time

For all five countries, the point prevalence of PsA patients treated with bDMARDs increased within the observational period of 2006–2017 (Supplementary Table S1, available at *Rheumatology* online). Sweden seems to have the most drastic point prevalence increase, followed by Iceland and Norway. The point prevalence for Finland cannot be estimated based on ROB-FIN due to lack of coverage after 2010.

Change of baseline characteristics over time

Fig. 1 shows the secular trends by baseline characteristics at the start of first-line bDMARDs. The figure includes six graphs that show the secular trends of CRP, disease duration, HAQ scores, VAS for pain, SJC and TJC. The strongest trends within the observational period 2006–2017 are the decreases in CRP, SJC and TJC across all the countries.

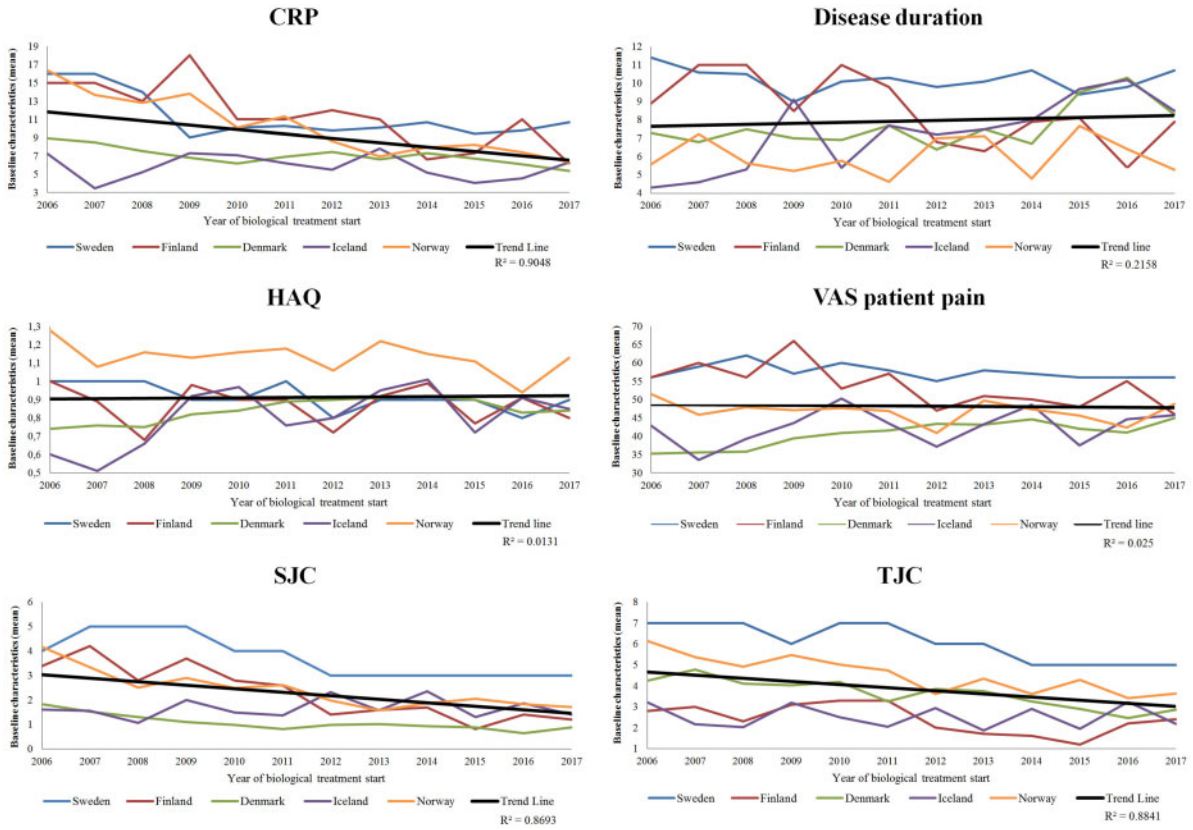
When considering CRP development from 2006 to 2017 in PsA patients, the linear trend line for all five nations indicates a strong association ($R^2 = 0.9048$). Iceland differed from the remaining countries with a lower CRP value across the observational period. The lower CRP values for Iceland are also evident in Table 1. For SJC and TJC the same pattern is detected as for CRP. All five countries display a strong association for baseline SJC ($R^2 = 0.8693$) and TJC ($R^2 = 0.8841$). The disease duration, HAQ scores and VAS for pain do not show any between-country associations ($R^2 < 0.5$), but the trends do indicate that at the start of their first bDMARD, PsA patients' baseline characteristics do not show any changes in HAQ scores or VAS for pain during 2006–2017.

Discussion

In this study we found that within the Nordic countries there was little evidence of variation in the PsA patient population. From 2006 to 2017 the age, female percentage, HAQ score, TJC and SJC all showed similar values. The baseline characteristics from 2006 to 2017 for all five countries showed that CRP and SJC similarly decreased and the HAQ score and VAS for pain scores remained high, indicating that despite less inflammatory activity, patients still had pain and disability.

All five Nordic countries had an increase in point prevalence of PsA patients treated with bDMARDs from 2006 to 2017. The number of PsA patients treated with bDMARDs increased more than the increase in population, and especially so for Sweden and Iceland. The treated PsA patient populations in Sweden and Norway increased very similarly, with almost identical point prevalence in 2015. Denmark differed, with a less prominent increase. This evident increase in bDMARD prescriptions from 2006 to 2017 may be attributed to rheumatologists being more willing and able to prescribe bDMARDs earlier and guidelines having changed over the years towards being more pro-biologics than they had been in the past. The increase in bDMARD prescriptions may also be attributed to the fact that more

FIG. 1 Biologic treatment initiators by baseline characteristics from 2006 to 2017



patients have been diagnosed with PsA or simply that the incidence of PsA has increased [27].

The baseline characteristics at the initiation of a first-line bDMARD for each country showed similarities in their secular trends (Fig. 1). Thus CRP, SJC and TJC displayed similarly decreasing trends during 2006–2017 across all five countries. When considering the development of HAQ scores, VAS for pain and disease duration, no between-country associations were evident and no significant trends were observed. Interestingly, the disease duration did not seem to change very much over time. This could indicate that the initiation of bDMARD treatment starts with lower inflammatory activity than previously but does not seem to be initiated earlier in the disease duration. This observation can be attributed to guideline changes, better access and coverage and the treating physician being more able and comfortable with prescribing bDMARDs.

Collectively this shows that the patient population had high HAQ scores and just as much pain, even though the inflammatory activity over time seemed to be lower at initiation of the first bDMARD. This presents a great challenge for treating physicians in the further treatment of patients with PsA, since no treatments have been shown to have a positive effect on low quality of life related to non-inflammatory disability and pain [2–9].

Interest in PsA has increased over the past several years due to several factors, including a better understanding of disease mechanisms, improved clinical trial designs and perhaps most importantly, the arrival of effective and relatively safe biologic agents that have dramatically altered the treatment paradigm [2]. This increased interest, as well as the heterogeneity of the disease requiring assessment of multiple PsA domains to identify appropriate treatments for individual patients [21], shows the importance of future studies with collaborations between different data registries and countries. Collaborations across registers will allow for robust assessment of the uptake of newer biologic therapies.

With this study, it has been shown that collaboration between the Nordic countries and data exchange is possible in pursuit of analyses that are based on a greater PsA patient population across country borders. All five of the Nordic countries have biologic registries that are integrated in the routine care of PsA patients and can therefore be considered valuable and relevant information sources.

Collaborations regarding bDMARD use for PsA patients should be considered important in order to be able to form coherent guidelines for future treatments and to understand the overall prescription patterns. National differences in the biologic registries, such as

registry coverage, prescription patterns and patient characteristics, should be considered in order to represent the data with scientific accuracy. The differences between the countries illustrate the challenge of merging data when the data collection basis is different for individual countries, along with some minor cultural and socio-environmental differences. The clear trends that span across all five countries in this study highlight the importance of grasping the difficulties in order to analyse a broader data set.

Despite the similarities within the Nordic countries, such as the healthcare systems with similar values and rules, there are considerable differences in their prescription patterns. These differences may be attributed to the considerable differences in rules and guidelines for prescription of bDMARDs between countries.

By analysing the baseline characteristics for all the Nordic countries collectively, it is evident that there is very little variation within the PsA population. From 2006 to 2017, the age, female percentage, HAQ score, TJC and SJC all showed similar values.

When considering the different prescription guidelines within each country and the continuing variation in first-choice bDMARDs [17], certain similarities in prescription patterns among the five countries still seem evident. The total yearly number of first-line bDMARD treatments increased significantly throughout the observational period, indicating a previously unmet need for biologic therapies in the Nordic population. All five countries showed a similar decline in the use of original bDMARDs when biosimilar therapies became available. This is especially evident for Iceland, Denmark, Sweden and Norway, which exhibited the most similar developments, but not for Finland to the same degree, as they differed from the others. For Finland, the differences can be attributed to the fact that biosimilars were implemented in clinics $\sim$2 years later than in the other countries. This is because of pricing and healthcare differences. The annual number of patients initiating first-generation TNFis both as first and subsequent lines of therapy decreased towards the end of the study period. This decrease was more than offset by a rapid increase in the initiation of second-generation TNFi treatments. Ustekinumab was primarily used as a second or subsequent line of therapy in PsA.

Strengths and limitations

Collaborations across registries allow for robust assessment of the uptake of newer bDMARDs and this is important for studying the similarities and differences within the PsA populations across countries and will help us develop a greater understanding of the disease.

The nature of an observational registry study confers some limitations regarding the reliability of the results. Incompleteness of data is an inherent problem within registry studies [12]. In terms of limitations, the open, observational setting entails inherent risks of bias in patient selection, assignment of treatment and the collection of clinical data. Moreover, the missing data for some outcomes is another frequent problem in observational studies. On the other hand, the observational setting also implies that patient inclusion is not restricted by any predefined level of disease activity, absence of comorbidity or rigid trial guidelines, but rather reflects clinical practice in the different countries. Another potential limitation of the study would be the lack of data on other domains of disease (enthesitis, skin and axial disease), which is a residual confounder we cannot account for. Furthermore, the inclusion of a 28-joint count only is a potential limitation, since a more comprehensive joint status would have increased the validity of the arthritis score in this study.

Conclusion

Across the Nordic countries, the prescription pattern for biologic therapies for PsA has changed significantly over time. The point prevalence and the number of PsA patients treated with bDMARDs increased from 2006 to 2017. In recent years, PsA patients have initiated bDMARDs with lower disease activity compared with previous years, suggesting that bDMARDs are initiated in patients with a less active inflammatory phenotype.

Collaboration across registers will allow for robust assessment of the uptake of newer biologic therapies. Prescription patterns for the Nordic countries have certain similarities, but because of the separate guidelines for each country's healthcare system, there are also differences.

Funding: This study was partly funded by a grant from NordForsk, FOREUM and the OAK Foundation (OCAY-18-774-OFIL).

Disclosure statement: TSJ is a member of speakers bureaus for AbbVie, Roche, Novartis, UCB, Biogen and Eli Lilly. LD has received research grants and/or lecture fees from MSD, UCB, Eli Lilly, Bristol-Myers Squibb and Janssen Pharmaceuticals. MLH has received research grants and/or lecture fees from Bristol-Myers Squibb, MSD, AbbVie, Roche, Eli Lilly, Pfizer, Orion and Novartis. BjG is a member of speakers bureaus for Novartis. JA has received research grants from AstraZeneca, UCB, Eli Lilly, Pfizer, Roche, Merck, Samsung and Janssen. LJ has received advisory board fees from AbbVie, Celegen, MSD, Novartis and UCB. JKW has received consultancy fees from AbbVie, Celgene, Eli Lilly, Novartis and UCB. DN is a member of speakers bureaus for AbbVie, Bristol-Myers Squibb, Eli Lilly, MSD, Novartis, Pfizer, Roche and UCB. TKK has received fees for speaking and/or consulting from AbbVie, Biogen, Bristol-Myers Squibb, Boehringer Ingelheim, Celgene, Celltrion, Eli Lilly, MDS, Mundipharma, Novartis, Oktal, Orio Pharma, Hospira/Pfizer, Roche, Sandoz and UCB and research funding to Diakonhjemmet Hospital from AbbVie, Bristol-Myers Squibb, Pfizer, Roche and UCB. BG has received research grants from Pfizer, Biogen and AbbVie. LEK is a

member of speakers bureaus for Pfizer, AbbVie, Amgen, UCB, Sanofi, Biogen, Gilead, Bristol-Myers Squibb, MSD, Novartis, Eli Lilly and Janssen. The other authors have declared no conflicts of interest.

Supplementary data

Supplementary data are available at *Rheumatology* online.

References

1 Kavanaugh A, Puig L, Gottlieb AB *et al*. Maintenance of clinical efficacy and radiographic benefit through two years of ustekinumab therapy in patients with active psoriatic arthritis: results from a randomized, placebo-controlled phase III trial. Arthritis Care Res (Hoboken) 2015;67:1739–49.

2 Ritchlin CT, Kavanaugh A, Gladman DD *et al*. Treatment recommendations for psoriatic arthritis. Ann Rheum Dis 2009;68:1387–94.

3 Gossec L, Smolen JS, Ramiro S *et al*. European League Against Rheumatism (EULAR) recommendations for the management of psoriatic arthritis: 2015 update. Ann Rheum Dis 2016;75:499–510.

4 Skougaard M, Jørgensen TS, Kristensen LE *et al*. Relationship between fatigue and inflammation, disease duration, and chronic pain in psoriatic arthritis: an observational DANBIO registry study. J Rheumatol 2020; 47:548–52.

5 Rosen CF, Mussani F, Chandran V *et al*. Patients with psoriatic arthritis have worse quality of life than those with psoriasis alone. Rheumatology 2012;51:571–6.

6 Walsh JA, McFadden ML, Morgan MD *et al*. Work productivity loss and fatigue in psoriatic arthritis. J Rheumatol 2014;41:1670–4.

7 Ballegaard C, Kristensen LE, Højgaard P *et al*. Impact of comorbidities on tumour necrosis factor inhibitor therapy in psoriatic arthritis: a population-based cohort study. Arthritis Care Res 2018;70:592–9.

8 Kristensen LE, Jørgensen TS, Christensen R *et al*. Societal costs and patients' experience of health inequities before and after diagnosis of psoriatic arthritis: a Danish cohort study. Ann Rheum Dis 2017;76:1495–501.

9 Kristensen LE, Englund M, Neovius M *et al*. Long-term work disability in patients with psoriatic arthritis treated with anti-tumour necrosis factor: a population-based regional Swedish cohort study. Ann Rheum Dis 2013;72:1675–9.

10 Fagerli KM, Lie E, van der Heijde D *et al*. Switching between TNF inhibitors in psoriatic arthritis: data from the NOR-DMARD study. Ann Rheum Dis 2013;72:1840–4.

11 British Association of Dermatologists. Onset of psoriatic arthritis during ustekinumab treatment for psoriasis: a case series of seven patients. Br J Dermatol 2015;173:272–4.

12 Kristensen LE, Lie E, Jacobsson LT *et al*. Effectiveness and feasibility associated with switching to a second or third TNF inhibitor in patients with psoriatic arthritis: a cohort study from southern Sweden. J Rheumatol 2016; 43:81–7.

13 Glintborg B, Østergaard M, Krogh NS *et al*. Clinical response, drug survival, and predictors thereof among 548 patients with psoriatic arthritis who switched tumor necrosis factor alfa inhibitor therapy. Arthritis Rheum 2013;65:1213–23.

14 Coates LC, Kavanaugh A, Mease PJ *et al*. Group for research and assessment of psoriasis and psoriasis arthritis 2015 treatment recommendations for psoriatic arthritis. Arthritis Rheum 2016;68:1069–71.

15 Taylor W, Gladman D, Helliwell P *et al*. Classification criteria for psoriatic arthritis: development of new criteria from a large international study. Arthritis Rheum 2006;54:2665–73.

16 Ramiro S, Smolen JS, Landewé R *et al*. Pharmacological treatment of psoriatic arthritis: a systematic literature review for the 2015 update of EULAR recommendations for the management of psoriatic arthritis. Ann Rheum Dis 2016;75:490–8.

17 Glintborg B, Lindström U, Aaltonen K *et al*. Biological treatment in ankylosing spondylitis in the Nordic countries during 2010–2016: a collaboration between five biological registries. Scand J Rheum 2018;47:465–74.

18 Kristensen LE, Gülfe A, Saxne T *et al*. Efficacy and tolerability of anti-tumour necrosis factor therapy in psoriatic arthritis patients: results from the South Swedish Arthritis Treatment Group register. Ann Rheum Dis 2007;67:364–9.

19 Li G, Sajobi TT, Menon BK *et al*. Registry-based randomized controlled trials– what are the advantages, challenges, and areas for future research? J Clin Epidemiol 2016;80:16–24.

20 Chatzidionysiou K, Hetland ML, Frisell T *et al*. Opportunities and challenges for real-world studies on chronic inflammatory joint diseases through data enrichment and collaboration between national registers: the Nordic example. RMD Open 2018;4:e000655.

21 Kela. 313 Abatasepti, Adalimumabi, Anakinra, Barisitinibi, Etanersepti, Golimumabi, Iksekitsumabi, Infliksimabi, Sarilumabi, Sekukinumabi, Sertolitsumabipegoli, Tofasitinibi, Tosilitsumabi Ja Ustekinumabi (Reumasairaudet). www.kela.fi/laake313 (29 April 2019, date last accessed).

22 Danmarks Statistik. Statistikbanken. www.statistikbanken.dk/HISB3 (29 April 2019, date last accessed).

23 Statistiska Centralbyrån. Population and population changes 1749–2018. www.scb.se/en/finding-statistics/statistics-by-subject-area/population/population-composition/population-statistics/pong/tables-and-graphs/yearly-statistics-the-whole-country/population-and-population-changes/ (29 April 2019, date last accessed).

24 Statistisk Sentralbyrå. www.ssb.no/befolkning/statistikker/folkemengde (29 April 2019, date last accessed).

25 Statistikcentralen. Statistik, Tilastokeskus. www.stat.fi/til/index_sv.html (29 April 2019, date last accessed).

26 Statistics Iceland, Hagstofa Íslands. www.statice.is/statistics/population/inhabitants/overview/ (29 April 2019, date last accessed).

27 Egeberg A, Kristensen LE, Thyssen JP *et al*. Incidence and prevalence of psoriatic arthritis in Denmark: a nationwide register linkage study. Ann Rheum Dis 2017; 76:1591–7.