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Impact of the COVID-19 pandemic on morbidity and mortality in patients with inflammatory joint diseases and in the general population: a nationwide Swedish cohort study

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ABSTRACT

Objectives To estimate absolute and relative risks for all-cause mortality and for severe COVID-19 in inflammatory joint diseases (IJDs) and with antirheumatic therapies.

Methods Through Swedish nationwide multiregister linkages, we selected all adult patients with rheumatoid arthritis (RA, n=53 455 in March 2020), other IJDs (here: spondyloarthropathies, psoriatic arthritis and juvenile idiopathic arthritis, n=57 112), their antirheumatic drug use, and individually matched population referents. We compared annual all-cause mortality March–September 2015 through 2020 within and across cohorts, and assessed absolute and relative risks for hospitalisation, admission to intensive care and death due to COVID-19 March–September 2020, using Cox regression.

Results During March–September 2020, the absolute all-cause mortality in RA and in other IJDs was higher than 2015–2019, but relative risks versus the general population (around 2 and 1.5) remained similar during 2020 compared with 2015–2019. Among patients with IJD, the risks of hospitalisation (0.5% vs 0.3% in their population referents), admission to intensive care (0.04% vs 0.03%) and death (0.10% vs 0.07%) due to COVID-19 were low. Antirheumatic drugs were not associated with increased risk of serious COVID-19 outcomes, although for certain drugs, precision was limited.

Conclusions Risks of severe COVID-19-related outcomes were increased among patients with IJDs, but risk increases were also seen for non-COVID-19 morbidity. Overall absolute and excess risks are low and the level of risk increases are largely proportionate to those in the general population, and explained by comorbidities. With possible exceptions, antirheumatic drugs do not have a major impact on these risks.

Key messages

What is already known about this subject?

- The impact of COVID-19 on morbidity and mortality among patients with rheumatoid arthritis and other inflammatory joint diseases (IJDs) is not completely understood. Since many of the available studies have internally compared characteristics among patients with different rheumatic diseases and COVID-19, absolute risks and how they relate (excess and relative risks) to the corresponding risks in the general population remain unknown, but are necessary for risk communication. For the same reason, the impact of disease-modifying antirheumatic drugs remains incompletely understood.

What does this study add?

- During the first period (March–September) of the COVID-19 pandemic in 2020, the increased all-cause mortality in all patients with rheumatoid arthritis and other IJDs was largely proportionate to that in the general population (relative risks around 2 and 1.5, respectively, that were not higher during 2020 than during 2015–2019), and largely explained by comorbidities.
- During March–September 2020, the average absolute risks for hospitalisation listing COVID-19 (0.5%), admission to intensive care due to COVID-19 (0.04%) and death due to COVID-19 (0.1%) in patients with IJDs were low, although higher than in the general population, corresponding to excess risks in the order of 0.2, 0.01 and 0.03 per 100 patients, respectively).
- With the possible exception of rituximab and JAK inhibitors, antirheumatic treatment does not appear to have a major impact on the risk of severe COVID-19.

INTRODUCTION

The SARS-CoV-2 pandemic has raised concerns regarding its impact in individuals with chronic inflammatory joint diseases (IJDs) such as rheumatoid arthritis (RA), with a morbidity and mortality pattern already higher than in the general population,[1–3] and with treatments (disease-modifying antirheumatic drugs, DMARDs) on the one hand linked with increased risks for serious infections, and on the other hand suggested to

Key messages

How might this impact on clinical practice or future developments?

- Our risk estimates may be used for patient counselling, and suggest that for COVID-19, the general health status matters more than a diagnosis of inflammatory joint disease per se, or its treatment. Signals for rituximab and JAK inhibitors call for replication.

exert beneficial effects on severe COVID-19.[4 5] These concerns have led to considerable challenges in clinical practice and for patient counselling.

Commendable efforts to address these questions have been carried out.[6–16] Local patient cohorts have been followed up through surveys,[7] local/regional hospital databases have been queried,[8 9] and the COVID-19 Global Rheumatology Alliance has established a repository of COVID-19 cases among patients with rheumatic diseases.[10] While providing preliminary evidence, interpretation of these results is not straightforward.[17] Studies based on questionnaires may miss fatal cases. Hospital queries may miss cases dying out of hospital. Case repositories based on active reporting suffer from unknown selection processes, and lack of external comparators make it impossible to assess absolute risks, let alone put these into context, for example, to COVID-19-related risks in individuals without rheumatic disease, or to risks in individuals with rheumatic disease but not COVID-19.

Through a COVID-19-specific update to a multiregister linkage by the Anti-Rheumatic Therapy in Sweden group, see for example,[18] we are able to address several of these outstanding issues by evaluating morbidity and mortality related to COVID-19 in nationwide, unselected cohorts of practically all patients with IJD, and individually matched general population referents, followed through a system of virtually complete national registers.

Our study has the following aims: (1) To assess whether the mortality among patients with IJDs, per se as well as compared with that of the general population, was different during the first period of the COVID-19 pandemic in 2020 compared with 2015–2019, (2) To assess absolute, excess and relative risks of COVID-19-related outcomes among patients with IJD compared with the general population, and (3) In relation to specific DMARDs.

SUBJECTS AND METHODS

Setting

Swedish healthcare is universally available to all residents. Patients with IJDs treated with DMARDs are managed by rheumatologists, mainly through hospital-based clinics. The COVID-19 pandemic had reached Sweden by March 2020, and by September 2020 resulted in 5000 deaths (online supplemental figure 1); one of the higher mortality rates per 100 000 inhabitants in Europe and the USA.[19] General recommendations (not legally binding) urged social distancing when possible, in particular for risk groups and those aged above 70 years. There have been no specific recommendations for patients with IJDs.

Patient and public involvement

This study was designed in response to frequent questions asked by patients with IJD, but did not contain any active patient or public involvement.

Data sources

We updated a previously described linkage between several national Swedish registers: the Swedish Rheumatology Quality Register (SRQ), The Patient Register, the Prescribed Drug Register, the Cause of Death Register and the Population Register, with data until September 2020, and added data on admission to intensive care units (ICUs) through linkage to the Intensive Care Quality Register (online supplemental table 1).

Study population

We used previously devised algorithms based on data from the Rheumatology Quality Register, International Classification of Diseases 10th Revision (ICD-10) codes in the Patient Register, and anatomical therapeutic chemical (ATC) codes in the Prescribed Drug Register (online supplemental table 2) to identify two open cohorts of individuals above 18 years; all prevalent RA March 2015 through September 2020 (n alive on 1 March 2020=53 455), and other IJDs (here: psoriatic arthritis, ankylosing spondylitis, other spondyloarthropathies, or juvenile idiopathic arthritis, n alive on 1 March 2020=57 112).[18 20] Each unique individual was matched on year of birth, sex and region of domicile (Sweden is organised in 21 regions) to five randomly selected population subjects (n alive 1 March 2020=484 277) from the Swedish Population Register, required to be alive and free from IJD at the time their index individual qualified into his/her cohort.

DMARD treatments

Among the individuals with IJD, and based on treatment data in the Rheumatology Quality Register and dispensing of DMARDs from the Prescribed Drug Register, we created DMARD cohorts defined by the treatment status 1 March 2020. We identified 33 296 individuals on active treatment with a conventional synthetic (cs) DMARD (methotrexate, sulfasalazine, antimalarials, leflunomide, or azathioprine, excluding those on biologic (b) or targeted synthetic (ts) DMARD), and 28 336 subjects on active treatment with any b/tsDMARD, defined as abatacept (n=1324), janus kinase inhibitors (JAKi) (baricitinib or tofacitinib, n=1725, baricitinib being the most common), rituximab (n=2180), tumour necrosis factor inhibitors (TNFi) adalimumab, certolizumab pegol, etanercept, golimumab or infliximab, n=22 070) and tocilizumab (n=1037). As only 2% changed their DMARD status between March and September 2020, we did not update the DMARD status over time.

Outcomes

We defined the following five outcomes: death from any cause (based on death notifications from the Tax agency), death from COVID-19 (based on main and contributory causes of death recorded on death certificates March until September 2020), hospitalisation for any cause and due to COVID-19 (data from the Patient Register), and admission to intensive care due to COVID-19 (the Intensive Care Register).

Covariates

The register linkage provided data on age, sex, region of domicile, characteristics of the IJD including disease activity score-28 (DAS28) and disease duration, concomitant csDMARD and steroid use, the prevalence of specific comorbid conditions including history of hospitalisations, educational level, country of birth and civil status at cohort entry (see online supplemental table 4 for definitions). All covariates were updated over time to

reflect status at start of follow-up, in each analysis. No imputation of missing data was performed.

Statistics

To assess whether the absolute all-cause mortality during March–September 2020 in each cohort differed compared with the corresponding time periods 2015–2019, we defined annual cohorts of all prevalent individuals with IJD, and of their matched population comparator subjects, on 1 March, and followed these until September each year, emigration or death. Within each cohort (RA, other IJD, population referents), we calculated weekly crude mortality rates as the number of deaths divided by person time for each year, and weekly excess mortality as the difference between the mortality during 2020 and the corresponding averages 2015–2019. We used Cox regression to estimate relative risks (expressed as HRs) comparing individuals with IJD to the general population March–September each year 2015 through 2020. We calculated unadjusted HRs (age, sex and region of domicile were accommodated through matching) as well as HRs adjusted for comorbidities, healthcare resource utilisation and socioeconomy; see tables 2 and 3 and online supplemental table 4 for details. We tested whether the mortality rate was higher in 2020 than during 2015–2019 by inclusion of an interaction term between indicator variables for year 2020, and for patients with IJD.

In each cohort, we next calculated absolute risks for hospitalisation, admission to intensive care and death due to COVID-19, defined as the ratio of the number of incident events 1 March through 1 September 2020 and the number of individuals at risk in each cohort 1 March 2020. We calculated excess risks (IJD vs the general population) as the difference in risk between the IJD and its population comparator cohort, and relative risks via unadjusted and adjusted Cox models as described above. To contextualise the COVID-19-related outcomes, we also assessed all-cause death and hospitalisation.

To investigate the association between DMARDs and each of the outcomes, we first estimated propensity scores for the probability of belonging to each DMARD group, separately for RA, other IJDs and all IJDs combined (online supplemental methods, online supplemental tables 8–10 and online supplemental figures 2–4). We then fitted inverse probability of treatment-weighted Cox regressions, additionally adjusted for use of oral glucocorticosteroids and csDMARD combinations (whether with csDMARD or b/tsDMARD). We abstained from calculating HRs for comparisons based on fewer than five events. The online supplemental materials describe a post hoc analysis of patients treated with sulfasalazine. We used Stata V.16.1 and SAS V.9.4.

RESULTS

All-cause mortality in IJDs and their matched general population subjects March–September 2020 and 2015–2019

Between 1 March and 1 September 2020 (55 336 person-years), 1310 (1.2%) of the 110 567 individuals with IJD died (968 (1.8%) with RA, and 342 (0.6%) with other IJDs), (tables 1–3). Figure 1 describes the weekly mortality rate in each IJD cohort and in their general population comparator cohorts during this period, and the average mortality rate in the corresponding

Table 1 Characteristics of adult Swedish residents with rheumatoid arthritis (RA) and other inflammatory joint diseases (IJDs, defined as ankylosing spondylitis, psoriatic arthritis, other spondyloarthropathies and juvenile idiopathic arthritis) in Sweden, 1 March 2020, and their matched general population comparator subjects

	RA	Other IJD	All IJDs combined	Matched general population referents*
Individuals*	53 455	57 112	110 567	484 277
Age, median (IQR)	69 (57 to 77)	55 (43 to 67)	62 (49 to 73)	60 (47 to 71)
Women	73%	51%	62%	62%
Years since diagnosis, median (IQR)	10 (5 to 16)	10 (5 to 15)	10 (5 to 16)	–
Comorbidities				
History of cancer	4%	3%	3%	3%
History of diabetes	14%	11%	12%	10%
History of heart failure	4%	2%	3%	2%
History of ischaemic heart disease	7%	4%	6%	3%
History of infections	7%	4%	5%	2%
History of lung diseases	11%	6%	9%	4%
History of kidney failure	4%	2%	3%	1%
History of stroke	4%	2%	3%	2%
History of joint surgery	18%	8%	12%	5%
History of venous thromboembolism	1.3%	0.7%	1.0%	0.5%
Highest achieved education				
<9 years	16%	6%	11%	9%
9–12 years	56%	60%	58%	55%
12+ years	28%	34%	31%	36%
Civil status: married	50%	48%	49%	48%
Born in Sweden	87%	90%	89%	84%
Hospitalisation: days past year, median (IQR), among hospitalised	5 (3 to 12)	4 (2 to 9)	5 (3 to 11)	4 (2 to 8)
Hospitalisation: days past 10 years to 1 year, median (IQR), among hospitalised	8 (4 to 21)	6 (3 to 14)	7 (3 to 17)	5 (3 to 11)

*Individually matched to each individual with an IJD, that is, to the column 'All IJDs combined'. Note that full variable definitions are presented in online supplemental table 4.

Table 2 All-cause mortality March–September each year 2015 through 2020 among Swedish residents with rheumatoid arthritis (RA), other inflammatory joint diseases (IJDs, defined as ankylosing spondylitis, psoriatic arthritis, other spondyloarthropathies and juvenile idiopathic arthritis), compared with their general population comparator subjects through HRs from Cox regression

Condition	Year	N deaths in the inflammatory joint disease cohort‡	HR model 1*	HR model 2†	P for interaction 2020 versus 2015–2019
All					
	2015	1077	1.99 (1.85 to 2.14)	1.13 (1.04 to 1.21)	
	2016	995	1.81 (1.68 to 1.95)	1.00 (0.92 to 1.08)	
	2017	1088	1.90 (1.77 to 2.04)	1.12 (1.04 to 1.20)	
	2018	1127	1.84 (1.72 to 1.98)	1.08 (1.00 to 1.16)	
	2019	1097	1.90 (1.77 to 2.04)	1.14 (1.06 to 1.23)	
	2020	1247	1.88 (1.76 to 2.01)	1.12 (1.04 to 1.20)	0.57
RA					
	2015	813	2.10 (1.93 to 2.28)	1.21 (1.11 to 1.32)	
	2016	756	1.93 (1.77 to 2.10)	1.07 (0.98 to 1.17)	
	2017	821	2.00 (1.84 to 2.18)	1.19 (1.09 to 1.29)	
	2018	833	1.94 (1.78 to 2.10)	1.13 (1.04 to 1.23)	
	2019	817	2.04 (1.88 to 2.22)	1.23 (1.13 to 1.34)	
	2020	925	1.99 (1.84 to 2.16)	1.18 (1.09 to 1.28)	0.80
Other IJD					
	2015	264	1.61 (1.40 to 1.85)	0.94 (0.82 to 1.09)	
	2016	239	1.41 (1.22 to 1.63)	0.83 (0.71 to 0.96)	
	2017	267	1.53 (1.34 to 1.76)	0.96 (0.84 to 1.11)	
	2018	294	1.52 (1.33 to 1.73)	0.94 (0.82 to 1.08)	
	2019	280	1.50 (1.31 to 1.71)	0.96 (0.83 to 1.10)	
	2020	322	1.52 (1.34 to 1.73)	0.96 (0.84 to 1.09)	0.66

*Cox model, matched for age, sex and geographical region.
†Cox model additionally adjusted for history of cancer, heart failure, ischaemic heart disease, infections, lung disease, kidney failure, stroke, joint surgery, venous thromboembolism, region of domicile, education, civil status, country of birth and time hospitalised in days (previous 10 years, and previous 1 year).
‡Note that follow-up in this table ends 18 August, which is why numbers and HRs differ slightly compared with all other analyses of all-cause mortality in which follow-up ends 1 September.

cohorts 2015 through 2019. In all cohorts, the mortality during 2020 was higher than during previous years. Figure 2 displays the excess mortality during 2020 (compared with the average in the same cohort 2015 through 2019). By mid-April 2020 (the peak of the period under study) the RA cohort had a more pronounced excess mortality than that observed in the general population.

Table 2 describes unadjusted and adjusted annual HRs of all-cause mortality in the IJD cohorts compared with general population comparators March until September (here: through August 18) each year 2015 through 2020. Unadjusted models demonstrated an increased mortality among individuals with RA (eg, HR 2020 = 1.99, 95% CI 1.84 to 2.16), and other IJD (eg, HR 2020 = 1.52, 95% CI 1.34 to 1.73). Importantly, the HRs for 2020 were not different from those of 2015 through 2019. Within each calendar year, once adjusted for comorbid conditions and socioeconomy, most of the increased mortality in RA (adjusted HR 2020 = 1.18, 95% CI 1.09 to 1.28), and all of the increased mortality in other IJD (adjusted HR 2020 = 0.96, 95% CI 0.84 to 1.09) disappeared.

Risks, excess risks and relative risks for COVID-19-related and other outcomes among individuals with IJD and in the general population March–September 2020

Among all individuals with IJD, the risk for hospitalisation because of COVID-19 during March through September 2020 was 0.5% (vs 0.3% in their general population referents), 0.04% (vs 0.03%) for admission to ICD due to COVID-19 and 0.10% (vs 0.07%) for death from COVID-19. For comparison, the absolute risk for hospitalisations for any cause was 8.1% (vs 5.0%) and the risk for death from any cause was 1.2% (vs 0.6%, table 3).

The unadjusted HRs for each of these outcomes were all elevated (with the exception of HRs for admission to intensive care due to COVID-19 in other IJDs) with somewhat higher HRs for the COVID-19-specific outcomes than for hospitalisation or for death from any cause in the RA cohort. Adjustment for comorbidities and socioeconomy lowered the associations between IJD and the COVID-19-related outcomes, though less clearly so for admission to intensive care (table 3).

COVID-19-related and other outcomes in relation to DMARDs

Online supplemental tables 5–7 display characteristics of the DMARD cohorts. Before weighting, there were differences across the DMARD cohorts. Online supplemental table 8–10 display the level of balancing achieved through the weighting, expressed as standardised mean differences. After weighting, all standardised mean differences were below 0.2.

Using csDMARDs as reference (see table 4 for crude risks and HRs), we noted no risk increase with b/tsDMARDs for hospitalisation listing COVID-19 (HR=1.08, 95% CI 0.73 to 1.58), admission to intensive care due to COVID-19 (HR=1.74, 95% CI 0.63 to 4.84) or death from COVID-19 (HR=1.26, 95% CI 0.60 to 2.64), nor for hospitalisation for any cause. When we assessed HRs for the above outcomes by individual b/tsDMARD (using csDMARD as reference) we noted no signal of increased risks with TNFi, abatacept and tocilizumab, but for several assessments the numbers of events were small. For rituximab,

Table 3 Absolute and relative risks for COVID-19-related events and other outcomes in Swedish residents with rheumatoid arthritis (RA), and other inflammatory joint diseases (IJDs, defined as ankylosing spondylitis, psoriatic arthritis, other spondyloarthropathies and juvenile idiopathic arthritis) compared with matched general population comparator subjects 1 March through September 2020

Condition	Outcome	N events (risk, %) in the IJD cohort	N events (risk, %) in the general population	Crude excess risk per 100 patients*	HR model 1†	HR model 2‡
All						
	Hospitalisation, all causes	8971 (8.1%)	24 273 (5.0%)	3.1	1.65 (1.61 to 1.69)	1.18 (1.15 to 1.21)
	Hospitalisation, COVID-19	581 (0.5%)	1443 (0.3%)	0.2	1.77 (1.61 to 1.95)	1.32 (1.19 to 1.46)
	Admission to ICU, COVID-19	45 (0.04%)	162 (0.03%)	0.01	1.22 (0.88 to 1.70)	1.17 (0.82 to 1.66)
	Death, all causes	1310 (1.2%)	3036 (0.6%)	0.6	1.90 (1.78 to 2.02)	1.13 (1.05 to 1.21)
	Death, COVID-19	161 (0.10%)	338 (0.07%)	0.03	2.09 (1.73 to 2.52)	1.18 (0.97 to 1.44)
RA						
	Hospitalisation, all causes	5275 (9.9%)	13 072 (5.9%)	4.0	1.71 (1.66 to 1.77)	1.21 (1.17 to 1.25)
	Hospitalisation, COVID-19	379 (0.7%)	784 (0.4%)	0.3	2.02 (1.78 to 2.28)	1.40 (1.23 to 1.60)
	Admission to ICU, COVID-19	31 (0.06%)	79 (0.04%)	0.02	1.63 (1.08 to 2.48)	1.53 (0.98 to 2.40)
	Death, all causes	968 (1.8%)	2026 (0.9%)	0.9	1.99 (1.85 to 2.15)	1.18 (1.09 to 1.28)
	Death, COVID-19	134 (0.30%)	245 (0.11%)	0.19	2.28 (1.85 to 2.81)	1.27 (1.02 to 1.59)
Other IJD						
	Hospitalisation, all causes	3696 (6.5%)	11 201 (4.3%)	2.2	1.54 (1.48 to 1.59)	1.16 (1.11 to 1.20)
	Hospitalisation, COVID-19	202 (0.4%)	659 (0.3%)	0.1	1.41 (1.20 to 1.65)	1.20 (1.02 to 1.41)
	Admission to ICU, COVID-19	14 (0.02%)	83 (0.03%)	−0.01	0.78 (0.44 to 1.37)	0.76 (0.43 to 1.37)
	Death, all causes	342 (0.6%)	1010 (0.4%)	0.2	1.56 (1.38 to 1.76)‡	0.98 (0.86 to 1.12)
	Death, COVID-19	27 (0.05%)	93 (0.04%)	0.01	1.34 (0.87 to 2.05)	0.83 (0.54 to 1.28)

*Defined as the difference between the risk in the inflammatory joint disease cohort and that in its matched population comparator cohort.
†Cox model unadjusted, matched for age, sex and geographical region; general population comparators are the reference.
‡Cox model additionally adjusted for history of cancer, diabetes, heart failure, ischaemic heart disease, infections, lung disease, kidney failure, stroke, joint surgery, venous thromboembolism, country of birth, highest educational achievement, civil status, region, number of days in hospital (in previous 1 year and 10 years).
ICU, intensive care unit.

we noted increased risks for death from COVID-19 (HR=3.20, 95% CI 1.19 to 8.57) and for death from any cause (HR=2.52, 95% CI 1.56 to 4.07). For JAKi, we noted increased risk for hospitalisation due to COVID-19 (HR=2.72, 95% CI 1.14 to 6.47) and death (HR=10.03, 95% CI 2.35 to 42.76) from COVID-19, both of which were higher than the HRs for hospitalisation and death from any cause.

In post hoc analysis contrasting patients on sulfasalazine monotherapy to patients on any other csDMARD therapy, we noted increased point estimates for hospitalisation and admission to ICU due to COVID-19 (details in online supplemental material).

DISCUSSION

We covered excess mortality and COVID-19-related outcomes among practically all patients with RA or other IJDs during the first period of the COVID-19 pandemic in the entire country of

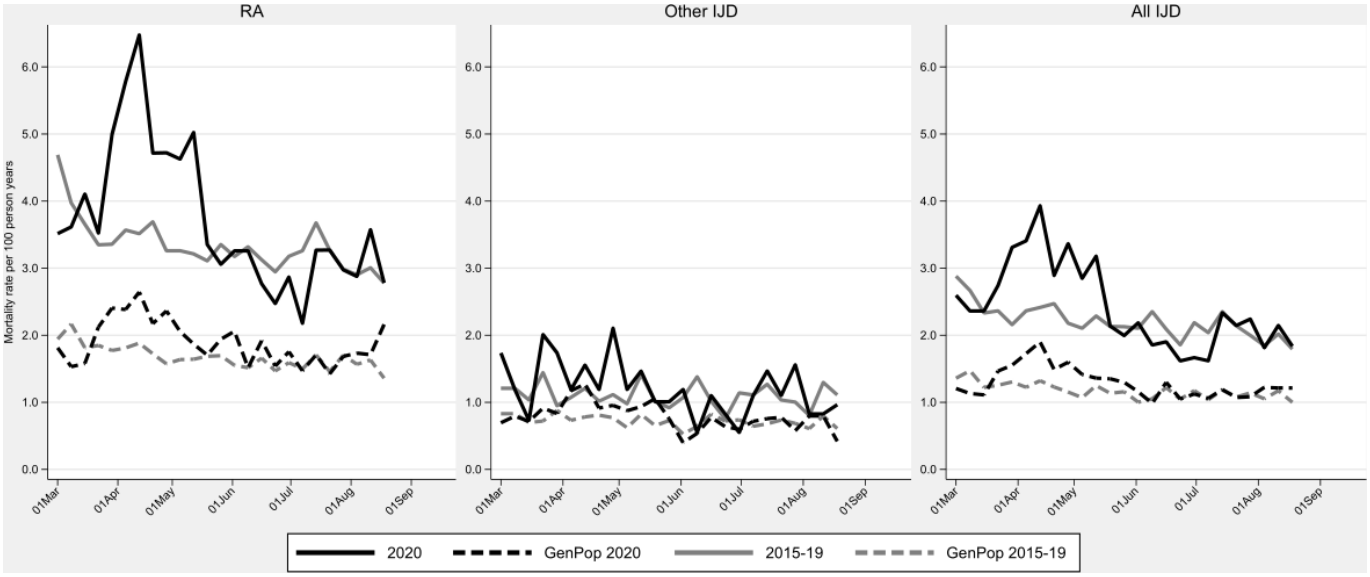

Figure 1 All-cause mortality in adult Swedish residents with rheumatoid arthritis (RA) or other inflammatory joint diseases (IJDs, defined as ankylosing spondylitis, psoriatic arthritis, other spondyloarthropathies and juvenile idiopathic arthritis), and among individually matched general population subjects, during 1 March until September 2020 compared with the corresponding average mortality during the same seasons 2015 through 2019.

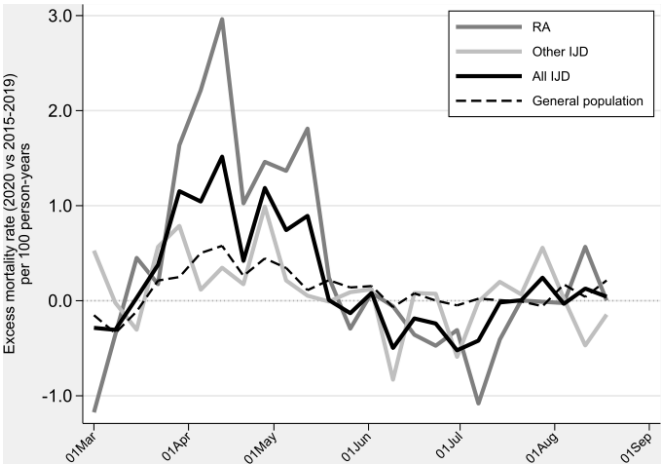

Figure 2 Difference (excess or deficit) in all-cause mortality for Swedish residents with rheumatoid arthritis (RA), other inflammatory joint diseases (IJDs, defined as ankylosing spondylitis, psoriatic arthritis, other spondyloarthropathies and juvenile idiopathic arthritis) and in their individually matched general population cohorts 1 March until September 2020, estimated as the difference between the mortality in each cohort 2020 compared with the average mortality in the same cohort during the same seasons 2015 through 2019.

Sweden. We made the following observations: (1) During the first period of the pandemic, patients with IJDs had approximately 1.5–2 times higher mortality from any cause than the general population. (2) In relative terms, this increase was not higher than during previous years, and could almost entirely be explained by comorbidities and socioeconomic factors. (3) In absolute terms, the risks for admission to hospital due to COVID-19 (0.5%, an additional 0.2 per 100 persons compared with the general population), to intensive care due to COVID-19 (0.04%, an additional 0.01 per 100 persons) and for death due to COVID-19 (0.10%, an additional 0.03 per 100 persons) among patients with IJDs were low. (4) The increased relative risks were not specific to COVID-19-related outcomes but present also for hospitalisations and deaths due to any cause. (5) Patients treated with b/tsDMARDs were, on average, not at higher risk for COVID-19-related outcomes than those on csDMARDs. (6) We noted increased risks for rituximab and for JAKi for COVID-19 outcomes, based on a limited number of events.

Taking differences in study design and the comparisons made (if any) in previous reports on COVID-19, our results add to the emerging picture that a diagnosis of chronic IJDs per se does not seem to increase the risk of serious COVID-19-related outcomes, but that age and comorbidities are strong risk factors for these outcomes.[6 9–13] This is not to say that IJDs themselves do not increase mortality—our study population comprised unselected patients with a mean disease duration around a decade. Many comorbidities and socioeconomic characteristics may thus have occurred as a consequence of the IJD. For the outcome admission to intensive care, adjustment had less effect on the HRs suggesting that other triaging may have been at play.

Our results extend previous findings on COVID-19 by anchoring them both to risks in individuals with IJD pre-COVID-19, to risks (excess and relative) versus the general population, and to risks not specifically from COVID-19. Importantly, our results indicate that during March–September of the pandemic 2020, the increase in all-cause mortality and the risks for COVID-19-related outcomes in patients with IJD remained largely proportional to those in the general population. Our results have important implications for patient counselling in that they suggest that (1) The absolute risk of death from COVID-19 among individuals with IJD between March and September was in the order of 1 in a 1000, (2) The additional risk in individuals with IJD compared with the general population was in the order of 3 per 10000, and (3) In a given individual with RA or another IJD, the health status seems much more important than the IJD diagnosis per se, both for overall mortality and for COVID-19-outcomes.

Previous reports have generally not suggested particular risks with TNFi or other cytokine inhibitors, at least when used in monotherapy,[6 8] and even suggested a protective effect of TNFi.[10] Our results suggest that csDMARDs, TNFi, abatacept and tocilizumab are neutral in terms of risks for serious COVID-19-outcomes. Baricitinib has been reported to exert beneficial

Table 4 Occurrence and relative risks of COVID-19-related events and other outcomes in individuals with chronic inflammatory joint diseases (rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, other spondyloarthropathies and juvenile idiopathic arthritis), 1 March through September 2020, according to DMARD treatment status 1 March

Outcome	Cohort	N events	Crude risk (%)	HR (95% CI)*
Hospitalisation, all causes	csDMARD	2805	8.4	1 (ref)
	TNFi	1288	5.8	0.99 (0.89 to 1.10)
	Abatacept	115	8.7	0.94 (0.69 to 1.26)
	Tocilizumab	79	7.6	0.92 (0.64 to 1.33)
	Rituximab	272	12.5	1.25 (1.02 to 1.53)
	JAKi	146	8.5	0.93 (0.67 to 1.27)
	All b/tsDMARDs	1900	6.7	0.99 (0.90 to 1.10)
Hospitalisation due to COVID-19	csDMARD	207	0.6	1 (ref)
	TNFi	67	0.3	1.05 (0.67 to 1.64)
	Abatacept	5	0.4	0.49 (0.15 to 1.59)
	Tocilizumab	4	0.4	–
	Rituximab	24	1.1	1.03 (0.58 to 1.81)
	JAKi	18	1.0	2.72 (1.14 to 6.47)
	All b/tsDMARDs	118	0.4	1.08 (0.73 to 1.58)
Admission to intensive care due to COVID-19	csDMARD	21	0.1	1 (ref)
	TNFi	8	0.0	2.05 (0.70 to 6.06)
	Abatacept	1	0.1	–
	Tocilizumab	0	0.0	–
	Rituximab	2	0.1	–
	JAKi	1	0.1	–
	All b/tsDMARDs	12	0.0	1.74 (0.63 to 4.84)
All-cause death	csDMARD	412	1.2	1 (ref)
	TNFi	73	0.3	0.71 (0.49 to 1.03)
	Abatacept	16	1.2	1.12 (0.50 to 2.48)
	Tocilizumab	7	0.7	1.11 (0.41 to 3.02)
	Rituximab	43	2.0	2.52 (1.56 to 4.07)
	JAKi	16	0.9	1.30 (0.52 to 3.26)
	All b/tsDMARDs	155	0.5	0.91 (0.67 to 1.24)
Death due to COVID-19	csDMARD	52	0.2	1 (ref)
	TNFi	7	0.0	1.03 (0.40 to 2.61)
	Abatacept	1	0.1	–
	Tocilizumab	2	0.2	–
	Rituximab	9	0.4	3.20 (1.19 to 8.57)
	JAKi	5	0.3	10.03 (2.35 to 42.76)
	All b/tsDMARDs	24	0.1	1.26 (0.60 to 2.64)

*HR from propensity score-weighted Cox regression, adjusted for oral steroids and csDMARD co-medication. Separate models for individual drugs and for all b/tsDMARDs. b/tsDMARD, biologic/targeted synthetic DMARD; csDMARD, conventional synthetic DMARD; DMARD, disease modifying antirheumatic drug.

effects when used against COVID-19.[21] While our results for JAKi are in seeming disagreement, they were based on small numbers and we cannot refute residual confounding. For rituximab, for which there is also substantial clinical channelling, the increased risks were not specific to COVID-19. Similar signals for rituximab have been observed in reports on bDMARDs and risks for other infections.[22] In either case, these results call for verification. An association between sulfasalazine and severe COVID-19 was recently reported.[23] Our post hoc analysis did not unequivocally confirm or reject this signal (online supplemental analysis). Because of the intimate correlation between disease activity and lack of alternative treatment options, and since we did not have prospective information on glucocorticoid dosing or disease activity from start of follow-up nor at the time point of any COVID-19 infection, we adjusted for but abstained from assessing risks specifically in relation to glucocorticoids.

Our study has limitations. We assessed risks for outcomes of known COVID-19 cases, but similar to most previous studies could not study risks for acquiring SARS-CoV-2 infection in the first place. While we had the possibility to compare risks between patients with IJDs to age-matched, sex-matched and domicile-matched general population referents, all risks presented represent averages across age and sex and are as such not directly applicable to individual patients. In the assessment of risks with individual DMARDs, we used a propensity score weighting approach to accommodate confounding by indication. For this, we included a wide array of covariates from several different domains and achieved good balance, but we cannot exclude residual confounding, and lack reliable data on several known COVID-19 risk factors such as body mass index and hypertension. We defined DMARD exposure on the basis of active treatment at the beginning of the study period, but can only speculate about patient-initiated discontinuations or dose reductions related to fear of COVID-19. Our results should therefore be viewed as an 'intention to treat' approach. Finally, while many of our results had good precision, some estimates were based on small numbers.

Our study has several strengths. Our study population encompassed virtually all DMARD-treated patients with RA, and other IJDs in the country and throughout the entire first period of the pandemic, thereby minimising bias due to patient selection. We could prospectively follow-up each individual through registers of high quality, with outcome information assigned independently of the IJD. This design enabled the estimation of absolute risks and of the corresponding relative risks comparing both within patients with inflammatory disease and versus the general population, rather than, for example, a restriction to internal comparisons within patients with rheumatic disease and COVID-19.[10]

In conclusion, the increased risks of hospitalisation and death due to COVID-19 among patients with IJDs largely mirror those in the general population, at least in relative terms. In absolute terms, risks and excess risks are low. csDMARDs, TNF inhibitors, abatacept and tocilizumab as used in clinical practice appear safe, but signals for rituximab and JAKis require verification to determine whether these are specific to COVID-19 or reflective of channelling. Finally, in demonstrating that the overall mortality in unselected patients with IJDs remains markedly elevated compared with the general population, also in the absence of COVID-19, our study serves as a reminder of a remaining large unmet need.

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Supplementary Materials

Supplementary Methods

Propensity scores were calculated for use as weights within the inverse probability weighted Cox proportional hazards models[1]. These propensity scores were estimated separately for treatment cohorts within the 1) all inflammatory joint diseases, and 2) RA cohorts. Note that due to low number of events, and balance not being achieved, between treatment cohort analyses using inverse propensity score weighting was not performed in the other IJD cohort. Propensity scores were also calculated separately when comparing the csDMARD to the b/tsDMARD groups in each of the three inflammatory joint disease cohorts.

Multinomial logistic (for the estimation of propensity scores within the six DMARD cohorts), and logistic regression models (for the estimation of propensity score within the csDMARD/b-tsDMARD cohorts) were fitted. All models contained the same covariates: history of cancer, diabetes, heart failure, ischemic heart disease, hospitalisation listing infection, lung disease, stroke, venous thromboembolic events, kidney failure, and surgery, age, sex, disease duration, DAS28, an indicator variable specifying whether the individual had received a different b/tsDMARD in the 180 days before start of follow-up, the number of previous b/tsDMARDs, days in hospital (both in the previous 10 years, and 1 year), region of domicile, educational level, civil status, and country of birth. See Supplementary Table 4 for definitions and the functional form of each of the covariates included in the propensity score model. The models additionally contained interactions between age and a history of lung disease, a history of lung disease and cancer, and age and region.

Stabilised inverse probability of treatment weights[2] were calculated from the propensity scores predicted from these models and were were additionally restricted to be no larger than the 99% and no smaller than the 1% centile of the distribution to further avoid extreme weight. The standardised mean bias[3] was used to determine whether balance had been reached when using stabilized weights; these are presented in Supplementary Tables 6-8. Subsequent Cox proportional hazards models used the robust sandwich estimator to calculate standard errors.

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Supplementary Analysis: Risks in patients on sulfasalazine

To assess risks for the outcomes under study specifically in patients on sulfasalazine, we have performed additional ad-hoc analyses, contrasting patients with any IJD on sulfasalazine monotherapy (N=4675) to patients on any csDMARD therapy (excluding sulfasalazine monotherapy, but including combination therapies of which sulfasalazine may form a part, N=28621), using the same analytic approach as for the other treatment comparisons.

In this select group of patients, absolute risks for the outcomes were in the same range as the other DMARD cohorts. We noted no increased risk for hospitalization for any cause (HR=1.08, 0.97-1.21, n exposed events: 381), increased point estimates for hospitalization listing COVID-19 (HR=1.52, 95% 1.05-2.20, n exposed events: 37), admission to ICU (HR=1.97 (95% CI 0.64-6.11, n exposed events: 4), but no increased risks for death from any cause (HR=0.96, 95% CI 0.70-1.31, n exposed events: 46, and no increased risks of death from COVID-19 (HR=0.97, 95% CI 0.40.2.32, n exposed events: 6).

Supplementary Table 1. Data sources included in the study

Swedish Rheumatology Quality Register (SRQ)	A nationwide longitudinal clinically integrated register operated by The Swedish Society for Rheumatology, started in 1996. Patients with RA and other rheumatologic diseases are registered in the SRQ by the treating rheumatologist. SRQ contains information about disease activity and additional information such as treatment and smoking status. SRQ covers 95% of all patients with RA treated with b/tsDMARD s in Sweden.
Swedish Patient Register (NPR)	A national register maintained by The National Board of Health and Welfare. Hospital discharges from inpatient care and patients visits in non-primary outpatient care, have been registered, since 1964 and 2001 respectively. Diagnoses are coded according to the Swedish version of the International Classification of Disease (ICD). The coverage of the inpatient part is close to 100%, for the outpatient part, the overall coverage is around 80% (higher for public than for private care-providers).
Prescribed Drug Register (PDR)	A national register maintained by The National Board of Health and Welfare. It contains information about all drugs dispensed on prescription in Sweden and is linked to the personal identification number since 2005. The coverage is close to 100%.
Swedish Population Register	A national register maintained by Swedish Tax agency. Contains information such as home district, civil status and migration data.
Longitudinal database for insurance and labor market-studies (LISA)	A national register maintained by Statistics Sweden. It contains information about sick leave, parental leave and employment status in Sweden from 1990
Cause of Death Register	The Cause of Death Register is a national register containing information on date and cause of death (underlying and contributory) for all deceased residents, including deaths among Swedish residents who died abroad. The register was started in 1952, and the data is considered complete since 1961. From that year and onward, cause of death is missing for less than 0.5% of deceased individuals, and in 2002, a validation study estimated that only 3.3% had any errors at the three digit level of the ICD-coded underlying cause of death
Swedish Intensive Care Quality Register (SIRS)	A national clinical register containing clinical information on patients admitted to intensive care from 2008 onwards. (https://www.icuregswe.org/en)

Supplementary Table 2: ICD10 and ATC codes used to define cohorts

Inflammatory joint disease cohort definitions		**DMARD treatment cohort definitions***	
Disease	**ICD10 code**	**DMARD**	**ATC code**
Rheumatoid arthritis	M05, M06	csDMARD	L04AX01, A07EC01, L04AD01, P01BA01, M01CB01, L04AA06, L04AX03, L01AA01, P01BA02, J01AA08, L04AA13, M01CC01
Psoriatic arthritis	M070, M071, M073, L405	TNFi	L04AB04, L04AB05, L04AB01, L04AB06, L04AB02
Ankylosing spondylitis	M45	Abatacept	L04AA24
Other spondyloarthropathies	M460, M461, M468, M469	Tocilizumab	L04AC07
Juvenile idiopathic arthritis	M08, M09	Rituximab	L01XC02
		JAKi	L04AA29, L04AA37, L04AA44

*As recorded in the Prescribed Drug Register

Supplementary Table3. Characteristics of Swedish residents with chronic inflammatory arthritis in Sweden March 1st, 2015-2019 combined and averaged, and their matched general population comparator subjects.

	RA	**Other IJD**	**All inflammatory joint disease**	**General population**
Average yearly individuals	52149	52127	104276	464819
Average yearly deaths	808	269	1077	2547
Age, Median (IQR)	68 (56-76)	54 (42-66)	61 (48-72)	59 (46-70)
Females	72%	51%	62%	62%
Time since diagnosis, median (IQR)	9.0 (4.0-14.0)	8.0 (4.0-13.0)	9.0 (4.0-13.0)	-
Comorbidities				
History of cancer	5%	4%	4%	4%
History of diabetes	13%	10%	11%	9%
History of heart failure	4%	2%	3%	2%
History of IHD	8%	4%	6%	3%
History of infections	7%	4%	5%	2%
History of lung diseases	11%	6%	9%	4%
History of kidney failure	3%	2%	3%	1%
History of stroke	4%	2%	3%	2%
History of joint surgery	19%	7%	13%	5%
History of VTE	1.2%	0.7%	1.0%	0.5%
Highest achieved education				
<9 years	18%	7%	13%	10%
9-12 years	55%	60%	58%	55%
12+ years	26%	33%	30%	35%
Civil status: Married	50%	48%	49%	48%
Born in Sweden (%)	88%	90%	89%	85%
Hospitalisation days past year, median (IQR)	6 (3-13)	4 (2-9)	5 (3-11)	4 (2-9)
Hospitalisation days: 10 years up to 1 year prior, median (IQR)	4 (0-14)	2 (0-7)	3 (0-10)	0 (0-5)

Supplementary Table 4: Description of covariates included in the propensity score estimation model.

Variable	**Description**
Comorbidity	
History of cancer	History of cancer recorded within 5 years prior to cohort entry. Data retrieved from the Cancer Register. Indicator variable (Y/N). Note that information on cancer diagnoses recorded in the Swedish Cancer Register was only available until December 31st 2018.
History of diabetes	History of diabetes recorded in the 10 years recorded prior to cohort entry. Defined as a record in the National Patient Register (inpatient and outpatient components, ICD10: E10-E11) or dispensation of treatment (ATC: A10) in the Prescribed Drug Register. Indicator variable (Y/N).
History of heart failure	History of heart failure recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient component, ICD10: I50). Indicator variable (Y/N).
History of ischemic heart disease.	History of ischemic heart disease recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient component, ICD10: I20-I25). Indicator variable (Y/N).
History of hospitalised infections	History of infections recorded in the 2 years prior to cohort entry. Defined as recorded in National Patient Register (inpatient component, ICD10: A00-B99, D73.3, E06.0, E32.1, G00-G02, G04.2, G05-G07, H00.0, H44.0, H60.0-H60.3, H66-H67, H70, I30.1, I40.0, J00-J22, J32, J34.0, J36, J38.3, J39.0-J39.1, J44.0, J85, J86, K04.4, K04.6, K04.7, K10.2, K11.3, K12.2, K14.0, K57.0, K57.2, K57.4, K57.8, K61, K63.0, K65.0, K65.1, K65.2, K65.9, L00-L08, L30.3, M00-M01, M46.2-M46.5, M60.0, M65.0, M71.0, M71.1, M72.6, M86, N10, N11, N12, N13.6, N15.1, N15.9, N30.0 N30.8, N34.0, N41.2, N43.1, N45.2, N45.3, N45.4, N48.2, N61, N70, N73, N75.1). Indicator variable (Y/N).
History of lung disease	History of lung disease other than infectious pneumonia recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, ICD10: J40-J94). Indicator variable (Y/N).
History of kidney failure	History of kidney failure recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, ICD10:N17-N19). Indicator variable (Y/N).
History of stroke	History of stroke recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, ICD10:I50-I69).

	Indicator variable (Y/N).
History of joint surgery	History of joint surgery recorded in the 10 years prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, operational codes: NGB, NFB, NBB, NHB, NHC, NHE, NHF, NHG, 8423, 8424, 8426, 8419, 8437, 8436, 8420, 8421, 8422, 8400-8415). Indicator variable (Y/N).
History of venous thrombotic event	History of VTE recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient component, ICD10:I82, I26). Indicator variable (Y/N).
Health-care resource utilisation	
Hospital days in the previous year	The number of days spent in hospital during the 365 days prior to cohort entry. Data obtained from the inpatient component of the National Patient Register. Categorised into 0, 1-3, and 4+ days.
Hospital days in the previous 10 years	The number of days spent in hospital during the period 10 years to 365 days prior to cohort entry. Data obtained from the inpatient component of the National Patient Register. Categorised into 0, 1-6, and 7+ days.
Socioeconomics	
Education	Highest education achieved as recorded in the year prior to cohort entry. Data obtained from the Longitudinal integrated database for health insurance and labour market studies (LISA). Note that education information was only available to 2018 in LISA so the value in 2018 was assumed for any subsequent years. Categorised into: 1= <9 years 2=9-12years 3=12years+
Civil status	Civil status recorded in the year prior to cohort entry. Data obtained from LISA, Note that civil status information was only available to 2017 in LISA so the value in 2017 was assumed for any subsequent years. Categorised into married/partner, or single.
Country of birth	Country of birth obtained from the Total Population Register categorised as Sweden, rest of Europe, and rest of world.
Disease-related	
DAS28	DAS28 value (ESR) from most recent rheumatology visit recorded in the SRQ within one year prior to start of follow-up. Categorised into remission (<2.6), low (2.6-3.1), moderate (3.2- 5.1), high (5.2+), and missing.
Disease duration	Disease duration in years, taken as the difference between the diagnosis date (defined using the disease selection definition and data in the National Patient register) and entry to cohort. Categorised as <2, 2-4, 5-9, 10+ years.

Treatment-related	
Number of previous b/tsDMARDs	Number of previous b/tsDMARDs prior to the treatment that caused entry to cohort. Identified by combining the PDR and SRQ. Categorised as 0, 1-2, 3+.
b/tsDMARD recorded in the previous 180 days	Identifies if a different b/tsDMARD was recorded in the previous 180 days prior to start. Indicator variable (Y/N).
Concomitant steroid use*	Dispensation of steroids (ATC: H02AB06) recorded in the Prescribed Drug Register in the 90 days prior to cohort entry.
Concomitant csDMARD use*	Concomitant csDMARD use defined as dispensation of csDMARD recorded in the Prescribed Drug Register within the 120 days prior to cohort entry where the dispensation occurs after the order date of the treatment defining the exposure cohort (ATC codes: L04AX01, A07EC01, L04AD01, P01BA01, M01CB01, L04AA06, L04AX03, L01AA01, P01BA02, J01AA08, L04AA13, M01CC01)

*Variables included in weighted Cox model not propensity score estimation model

Supplementary Table 5. Characteristics of Swedish residents with chronic inflammatory joint diseases (RA, PsA, AS, SpA and JIA) according to their DMARD treatment status on March 1st 2020.

	csDMARD*	TNFi	Abatacept	Tocilizumab	Rituximab	JAKi	All b/tsDMARDs combined
Individuals	33296	22070	1324	1037	2180	1725	28336
Age at entry, median (IQR)	67 (55-75)	54 (42-66)	65 (54-73)	62 (50-72)	68 (58-75)	60 (49-69)	57 (44-68)
Female	65%	58%	79%	79%	77%	79%	62%
Time since diagnosis, median (IQR)	8.9 (4.5-14.7)	9.6 (4.8-15.5)	12.1 (6.4-17.6)	11.8 (6.8-17.4)	13.8 (8.9-18.2)	11.0 (5.7-16.9)	10.3 (5.3-16.1)
DAS28ESR at most recent visit during last 12 months (if any)							
Median (IQR)	2.6 (1.9-3.4)	2.4 (1.7-3.3)	3.1 (2.4-4.3)	1.8 (1.1-3.2)	2.9 (2.1-3.9)	3.3 (2.5-4.4)	2.5 (1.8-3.6)
Remission	52%	56%	32%	65%	43%	30%	52%
Low	19%	16%	21%	10%	18%	15%	16%
Moderate	26%	24%	36%	17%	31%	40%	27%
High	4%	4%	10%	8%	8%	15%	6%
No visit with complete DAS28 data	76%	66%	56%	59%	49%	54%	63%
N previous b/tsDMARDs (median) (IQR)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	1.0 (1.0-2.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	2.0 (1.0-3.0)	0.0 (0.0-1.0)
On other bDMARD in past 180 days (%)	1%	5%	16%	16%	10%	16%	7%
Concomitant therapies							
csDMARDs	100%	37%	42%	31%	37%	31%	37%
Steroids	22%	14%	37%	33%	31%	34%	19%
Comorbidities							

History of cancer	4%	1%	2%	1%	5%	2%	2%
History of diabetes	14%	9%	15%	11%	15%	12%	10%
History of heart failure	4%	1%	4%	2%	4%	2%	2%
History of IHD	6%	3%	7%	3%	8%	5%	4%
History of infections	6%	3%	9%	5%	10%	8%	4%
History of lung diseases	9%	6%	16%	10%	17%	11%	8%
History of kidney failure	3%	2%	3%	3%	3%	2%	2%
History of stroke	4%	2%	3%	2%	3%	2%	2%
History of joint surgery	14%	12%	25%	24%	26%	22%	15%
History of VTE	1%	1%	1%	1%	2%	1%	1%
Highest acheived education							
<9 years	14%	5%	11%	8%	11%	7%	6%
9-12 years	59%	59%	58%	60%	60%	59%	59%
12+ years	27%	36%	31%	32%	29%	33%	35%
Civil status, married	51%	49%	52%	49%	50%	49%	49%
Born in Sweden	89%	88%	88%	88%	84%	86%	88%
N hospitalisation days in past 365 days**, median (IQR)	5.0 (3.0-11.0)	4.0 (2.0-7.0)	5.0 (3.0-12.0)	4.0 (3.0-7.0)	5.0 (3.0-11.0)	5.0 (3.0-12.0)	4.0 (2.0-8.0)
N hospitalisation days the 10 years prior, up to 1 year prior**, median (IQR)	2.0 (0.0-9.0)	2.0 (0.0-6.0)	5.0 (0.0-14.0)	4.0 (0.0-12.0)	6.0 (1.0-18.0)	4.0 (0.0-13.0)	2.0 (0.0-8.0)

*Defined as methotrexate, sulfasalazine, anti-malarials, and leflunomide. ** of those with a hospitalisation

Supplementary Table 6. Characteristics of Swedish residents with chronic inflammatory joint diseases (RA only) according to their DMARD treatment status on March 1st 2020.

	csDMARD*	TNFi	Abatacept	Tocilizumab	Rituximab	JAKi	All b/tsDMARDs combined
Individuals	22904	10463	1221	942	2150	1384	16160
Age at entry (median), IQR	70 (60-77)	62 (51-71)	66 (56-74)	63 (53-72)	68 (58-75)	62 (52-71)	64 (52-72)
Female	71%	75%	80%	79%	77%	81%	76%
Time since diagnosis, median (IQR)	8.9 (4.4-14.8)	11.1 (5.9-16.7)	12.2 (6.6-17.7)	12.0 (6.9-17.5)	13.8 (9.0-18.3)	11.7 (6.2-17.4)	11.6 (6.4-17.1)
DAS28ESR at most recent visit during last 12 months (if any)							
Median (IQR)	2.6 (1.9-3.4)	2.6 (1.9-3.6)	3.0 (2.4-4.3)	1.9 (1.1-3.3)	2.9 (2.1-3.9)	3.3 (2.5-4.4)	2.7 (2.0-3.8)
Remission	51%	49%	33%	64%	43%	31%	46%
Low	19%	17%	21%	10%	18%	15%	17%
Moderate	26%	29%	36%	17%	32%	40%	30%
High	4%	5%	11%	9%	8%	14%	7%
No. visit with complete DAS28 data	72%	59%	56%	58%	49%	53%	57%
N previous b/tsDMARDs (median) (IQR)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	2.0 (1.0-3.0)	0.0 (0.0-1.0)
On other bDMARD in past 180 days (%)	1%	5%	16%	16%	10%	16%	8%
Concomitant therapies							
csDMARDs	100%	51%	43%	31%	37%	32%	46%
Steroids	26%	21%	38%	33%	31%	36%	26%
Comorbidities							

History of cancer	5%	1%	2%	1%	5%	2%	2%
History of diabetes	14%	10%	15%	11%	15%	12%	11%
History of heart failure	4%	2%	4%	2%	4%	2%	2%
History of IHD	7%	4%	8%	3%	8%	5%	5%
History of infections	6%	4%	9%	5%	10%	8%	6%
History of lung diseases	11%	7%	17%	10%	17%	12%	10%
History of kidney failure	3%	2%	3%	3%	3%	2%	2%
History of stroke	4%	2%	4%	2%	4%	2%	2%
History of joint surgery	16%	19%	25%	24%	26%	25%	21%
History of VTE	1%	1%	1%	1%	2%	2%	1%
Highest acheived education							
<9 years	18%	9%	11%	8%	11%	8%	9%
9-12 years	57%	57%	58%	60%	60%	59%	57%
12+ years	26%	35%	31%	32%	29%	33%	33%
Civil status, married	51%	52%	53%	52%	50%	50%	52%
Born in Sweden	88%	87%	88%	87%	84%	85%	87%
N hospitalisation days in past 365 days**, median (IQR)	5.0 (3.0-11.0)	4.0 (2.0-8.0)	5.0 (3.0-12.0)	4.0 (3.0-7.0)	5.0 (3.0-11.0)	5.0 (3.0-11.0)	5.0 (3.0-9.0)
N hospitalisation days the 10 years prior, up to 1 year prior**, median (IQR)	3.0 (0.0-10.0)	2.0 (0.0-7.0)	5.0 (0.0-15.0)	4.0 (0.0-12.0)	6.0 (1.0-18.0)	4.0 (0.0-13.0)	3.0 (0.0-10.0)

*Defined as methotrexate, sulfasalazine, anti-malarials, and leflunomide. ** of those with a hospitalization

Supplementary Table 7. Characteristics of Swedish residents with chronic inflammatory joint diseases (PsA, AS,SpA and JIA only) according to their DMARD treatment status on March 1st 2020.

	csDMARD*	TNFi	Abatacept	Tocilizumab	Rituximab	JAKi	All b/tsDMARDs combined
Individuals	10392	11607	103	95	30	341	12176
Age at entry (median), IQR	59 (47-69)	48 (37-58)	47 (29-58)	30 (24-56)	47 (27-62)	51 (37-60)	48 (36-58)
Female	51%	43%	71%	78%	80%	70%	44%
Time since diagnosis, median (IQR)	8.9 (4.7-14.4)	8.4 (4.1-14.1)	9.3 (4.6-15.5)	9.2 (5.6-16.8)	10.2 (6.2-15.1)	8.1 (4.3-14.7)	8.4 (4.1-14.1)
DAS28ESR at most recent visit during last 12 months (if any)							
Median (IQR)	2.5 (1.8-3.3)	2.1 (1.5-3.0)	3.2 (2.5-4.1)	1.0 (0.8-2.2)	4.8 (2.2-5.3)	3.4 (2.6-4.8)	2.2 (1.5-3.1)
Remission	54%	66%	28%	83%	33%	28%	64%
Low	19%	14%	21%	3%	11%	15%	14%
Moderate	25%	18%	46%	14%	22%	39%	20%
High	3%	3%	5%	0%	33%	18%	3%
No visit with complete DAS28 data	84%	72%	62%	69%	70%	57%	71%
N previous b/tsDMARDs (median) (IQR)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	1.0 (1.0-3.0)	2.0 (1.0-3.0)	0.0 (0.0-1.0)
On other bDMARD in past 180 days (%)	1%	5%	22%	15%	23%	15%	6%
Concomitant therapies							
csDMARDs	100%	25%	26%	22%	23%	28%	25%
Steroids	11%	8%	27%	28%	23%	30%	9%
Comorbidities							

History of cancer	3%	1%	0%	1%	3%	2%	1%
History of diabetes	13%	8%	8%	5%	13%	13%	9%
History of heart failure	2%	1%	1%	0%	3%	1%	1%
History of IHD	5%	2%	4%	1%	3%	3%	2%
History of infections	4%	2%	5%	3%	7%	9%	3%
History of lung diseases	6%	4%	13%	7%	20%	6%	5%
History of kidney failure	2%	2%	4%	2%	3%	2%	2%
History of stroke	2%	1%	2%	0%	0%	1%	1%
History of joint surgery	10%	6%	17%	21%	13%	11%	7%
History of VTE	1%	0%	0%	2%	3%	1%	0%
Highest acheived education							
<9 years	7%	2%	6%	3%		3%	3%
9-12 years	63%	61%	66%	58%	70%	63%	61%
12+ years	31%	37%	28%	39%	30%	34%	37%
Civil status, married	51%	46%	39%	24%	43%	45%	45%
Born in Sweden	92%	89%	92%	94%	90%	93%	89%
N hospitalisation days in past 365 days**, median (IQR)	4.0 (2.0-8.0)	3.0 (2.0-6.0)	2.0 (2.0-6.0)	5.0 (3.0-6.0)	10.0 (2.0-46.0)	4.0 (3.0-19.0)	3.0 (2.0-6.0)
N hospitalisation days the 10 years prior, up to 1 year prior**, median (IQR)	2.0 (0.0-7.0)	0.0 (0.0-5.0)	4.0 (0.0-9.0)	5.0 (2.0-13.0)	5.0 (2.0-11.0)	4.0 (0.0-11.0)	0.0 (0.0-5.0)

*Defined as methotrexate, sulfasalazine, anti-malarials, and leflunomide. ** of those with a hospitalisation

Supplementary Table 8: Standardised mean differences from propensity score weighting for all variables included in the csDMARD vs. b/tsDMARD analyses.

	All inflammatory diseases				RA				Other IJD			
	csDMARD		b/tsDMARD		csDMARD		b/tsDMARD		csDMARD		b/tsDMARD	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Age												
<55	-0.453	-0.045	0.453	0.045	-0.312	-0.035	0.312	0.035	-0.528	-0.046	0.528	0.046
55-64	-0.052	0.000	0.052	0.000	-0.143	-0.009	0.143	0.009	0.108	0.012	-0.108	-0.012
65-69	0.061	0.001	-0.061	-0.001	-0.026	-0.005	0.026	0.005	0.191	0.013	-0.191	-0.013
70-74	0.152	0.008	-0.152	-0.008	0.065	0.001	-0.065	-0.001	0.267	0.013	-0.267	-0.013
75-79	0.202	0.011	-0.202	-0.011	0.148	0.007	-0.148	-0.007	0.249	0.014	-0.249	-0.014
80-84	0.229	0.022	-0.229	-0.022	0.213	0.019	-0.213	-0.019	0.208	0.033	-0.208	-0.033
85+	0.252	0.050	-0.252	-0.050	0.268	0.052	-0.268	-0.052	0.144	0.037	-0.144	-0.037
bDMARD previous 180 days	-0.344	-0.069	0.344	0.069	-0.399	-0.083	0.399	0.083	-0.267	-0.048	0.267	0.048
Civil status	-0.039	0.001	0.039	-0.001	0.017	0.012	-0.017	-0.012	-0.114	-0.015	0.114	0.015
Country of birth												
Sweden	0.043	0.007	-0.043	-0.007	0.031	-0.002	-0.031	0.002	0.094	0.034	-0.094	-0.034
Europe	0.000	0.003	0.000	-0.003	-0.012	0.001	0.012	-0.001	-0.009	-0.003	0.009	0.003
Rest of world	-0.067	-0.015	0.067	0.015	-0.035	0.003	0.035	-0.003	-0.132	-0.048	0.132	0.048
DAS28												
Remission	-0.178	-0.021	0.178	0.021	-0.143	-0.021	0.143	0.021	-0.276	-0.021	0.276	0.021
Low	-0.055	-0.006	0.055	0.006	-0.084	-0.012	0.084	0.012	-0.042	0.003	0.042	-0.003
Moderate	-0.132	-0.001	0.132	0.001	-0.193	-0.012	0.193	0.012	-0.074	0.017	0.074	-0.017
High	-0.095	0.001	0.095	-0.001	-0.132	-0.007	0.132	0.007	-0.055	0.006	0.055	-0.006
Missing	0.270	0.019	-0.270	-0.019	0.312	0.032	-0.312	-0.032	0.294	0.006	-0.294	-0.006

Disease duration												
<2 years	0.051	-0.022	-0.051	0.022	0.141	-0.017	-0.141	0.017	-0.073	-0.020	0.073	0.020
2-4 years	0.078	0.000	-0.078	0.000	0.154	0.011	-0.154	-0.011	-0.019	-0.015	0.019	0.015
5-9 years	0.043	0.005	-0.043	-0.005	0.069	0.005	-0.069	-0.005	0.023	0.004	-0.023	-0.004
10+ years	-0.126	0.009	0.126	-0.009	-0.252	-0.002	0.252	0.002	0.039	0.020	-0.039	-0.020
Education												
<9 years	0.253	0.025	-0.253	-0.025	0.239	0.029	-0.239	-0.029	0.201	0.022	-0.201	-0.022
9-12 years	-0.009	0.000	0.009	0.000	-0.015	-0.005	0.015	0.005	0.032	0.002	-0.032	-0.002
12+ years	-0.159	-0.017	0.159	0.017	-0.167	-0.016	0.167	0.016	-0.120	-0.012	0.120	0.012
Female	0.045	-0.002	-0.045	0.002	-0.120	-0.008	0.120	0.008	0.138	0.000	-0.138	0.000
Hospital days (prev 10 years)												
0	-0.023	-0.016	0.023	0.016	0.050	-0.007	-0.050	0.007	-0.080	-0.024	0.080	0.024
1-6	-0.047	-0.001	0.047	0.001	-0.066	-0.008	0.066	0.008	-0.011	0.009	0.011	-0.009
7+	0.071	0.019	-0.071	-0.019	0.011	0.015	-0.011	-0.015	0.108	0.018	-0.108	-0.018
Hospital days (previous year)												
0	-0.080	-0.008	0.080	0.008	-0.054	-0.004	0.054	0.004	-0.077	-0.008	0.077	0.008
1-3	0.009	-0.001	-0.009	0.001	-0.001	-0.006	0.001	0.006	0.012	0.004	-0.012	-0.004
4+	0.092	0.011	-0.092	-0.011	0.066	0.010	-0.066	-0.010	0.091	0.006	-0.091	-0.006
Comorbiditie s												
Cancer	0.164	0.017	-0.164	-0.017	0.150	0.015	-0.150	-0.015	0.174	0.021	-0.174	-0.021
Diabetes	0.109	0.015	-0.109	-0.015	0.077	0.012	-0.077	-0.012	0.150	0.021	-0.150	-0.021
Heart failure	0.126	0.022	-0.126	-0.022	0.108	0.022	-0.108	-0.022	0.132	0.017	-0.132	-0.017
IHD	0.116	0.012	-0.116	-0.012	0.091	0.009	-0.091	-0.009	0.135	0.014	-0.135	-0.014

Infections	0.057	0.013	-0.057	-0.013	0.030	0.006	-0.030	-0.006	0.073	0.019	-0.073	-0.019
Kidney failure	0.043	0.007	-0.043	-0.007	0.039	0.006	-0.039	-0.006	0.038	0.008	-0.038	-0.008
Lung disease	0.059	0.004	-0.059	-0.004	0.029	-0.001	-0.029	0.001	0.062	0.007	-0.062	-0.007
Stroke	0.100	0.007	-0.100	-0.007	0.094	0.006	-0.094	-0.006	0.078	0.005	-0.078	-0.005
Joint surgery	-0.016	0.010	0.016	-0.010	-0.118	0.005	0.118	-0.005	0.106	0.013	-0.106	-0.013
VTE	0.045	0.008	-0.045	-0.008	0.041	0.007	-0.041	-0.007	0.033	0.002	-0.033	-0.002
N previous biologics												
0	0.721	0.040	-0.721	-0.040	0.819	0.045	-0.819	-0.045	0.574	0.036	-0.574	-0.036
1-2	-0.620	-0.039	0.620	0.039	-0.686	-0.040	0.686	0.040	-0.518	-0.039	0.518	0.039
3+	-0.292	-0.007	0.292	0.007	-0.365	-0.016	0.365	0.016	-0.183	0.003	0.183	-0.003
Region												
North	0.083	0.006	-0.083	-0.006	0.081	0.002	-0.081	-0.002	0.086	0.010	-0.086	-0.010
South	0.015	0.003	-0.015	-0.003	0.009	0.003	-0.009	-0.003	0.021	-0.001	-0.021	0.001
Southeast	0.093	0.014	-0.093	-0.014	0.091	0.020	-0.091	-0.020	0.099	0.006	-0.099	-0.006
Stockholm	-0.176	-0.016	0.176	0.016	-0.161	-0.021	0.161	0.021	-0.209	-0.007	0.209	0.007
Uppsala/ Örebro	0.012	-0.001	-0.012	0.001	0.021	-0.003	-0.021	0.003	0.007	-0.002	-0.007	0.002
West	0.008	-0.002	-0.008	0.002	-0.007	0.003	0.007	-0.003	0.037	-0.003	-0.037	0.003

Supplementary Table 9: Standardised mean differences from propensity score weighting for all variables included in the treatment comparison between specific DMARDs, RA only

	csDMARD		TNFi		Abatacept		Tocilizumab		Rituximab		JAKi	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Age												
<55	-0.312	-0.038	0.348	0.034	0.012	0.108	0.163	0.062	-0.083	-0.060	0.218	0.025
55-64	-0.143	-0.001	0.113	0.003	0.092	-0.051	0.108	0.051	0.023	-0.010	0.174	0.018
65-69	-0.026	-0.003	0.006	0.004	0.042	-0.005	0.022	-0.040	0.056	0.022	0.010	-0.002
70-74	0.065	0.005	-0.073	0.008	0.003	-0.062	-0.016	-0.035	0.055	0.012	-0.119	-0.020
75-79	0.148	0.003	-0.161	-0.012	-0.006	-0.011	-0.086	0.028	0.025	0.022	-0.098	0.007
80-84	0.213	0.013	-0.198	-0.023	-0.125	0.034	-0.128	0.001	-0.012	0.011	-0.153	-0.007
85+	0.268	0.046	-0.236	-0.038	-0.092	-0.023	-0.208	-0.132	-0.091	0.027	-0.187	-0.045
bDMARD previous 180 days	-0.399	-0.077	0.106	0.048	0.642	0.076	0.680	0.096	0.346	0.058	0.663	0.064
Civil status	0.017	0.001	-0.027	-0.017	-0.037	-0.028	-0.007	-0.030	0.035	0.079	0.017	0.027
Country of birth												
Sweden	0.031	0.009	-0.001	0.007	0.020	-0.047	-0.007	0.006	-0.098	0.001	-0.083	-0.071
Europe	-0.012	-0.008	-0.004	-0.009	-0.022	0.068	-0.029	-0.065	0.071	0.029	0.037	0.050
Rest of world	-0.035	-0.004	0.006	0.001	-0.003	-0.015	0.049	0.078	0.063	-0.040	0.085	0.048
DAS28												
Remission	-0.143	-0.020	0.125	0.014	-0.062	0.023	0.280	0.020	0.146	0.029	-0.066	-0.020
Low	-0.084	-0.011	0.048	0.014	0.140	0.057	-0.081	-0.036	0.137	-0.007	0.043	-0.024
Moderate	-0.193	-0.014	0.098	-0.005	0.216	0.027	-0.087	-0.010	0.234	0.050	0.322	0.044
High	-0.132	-0.008	0.009	-0.007	0.214	-0.010	0.132	0.012	0.164	0.037	0.356	0.045
Missing	0.312	0.032	-0.186	-0.013	-0.217	-0.061	-0.162	0.005	-0.376	-0.061	-0.272	-0.013
Disease duration												
<2 years	0.141	-0.023	-0.062	0.020	-0.129	0.105	-0.176	-0.050	-0.252	-0.076	-0.027	0.110
2-4 years	0.154	0.010	-0.080	-0.014	-0.080	0.029	-0.135	-0.018	-0.241	-0.020	-0.108	0.029

5-9 years	0.069	0.004	-0.037	-0.012	-0.086	0.002	0.008	0.024	-0.094	0.025	-0.062	-0.014
10+ years	-0.252	0.003	0.125	0.009	0.205	-0.081	0.190	0.021	0.399	0.035	0.149	-0.071
Education												
<9 years	0.239	0.025	-0.208	-0.021	-0.087	-0.049	-0.175	-0.038	-0.082	-0.014	-0.178	0.029
9-12 years	-0.015	-0.006	-0.011	0.009	0.010	0.032	0.062	0.007	0.056	-0.014	0.032	-0.022
12+ years	-0.167	-0.013	0.171	0.006	0.056	0.002	0.067	0.022	0.002	0.026	0.101	0.002
Female	-0.120	-0.024	0.053	0.005	0.155	0.067	0.141	-0.001	0.088	0.030	0.183	0.044
Hospital days (previous 10 years)												
0	0.050	0.000	0.090	0.025	-0.209	-0.049	-0.111	-0.039	-0.293	-0.107	-0.166	0.080
1-6	-0.066	-0.013	0.071	0.008	0.017	0.029	0.011	-0.010	0.005	0.007	0.032	0.020
7+	0.011	0.012	-0.160	-0.033	0.199	0.023	0.104	0.049	0.298	0.104	0.140	-0.101
Hospital days (previous year)												
0	-0.054	-0.002	0.128	0.026	-0.087	-0.052	0.081	-0.011	-0.157	-0.096	-0.088	0.055
1-3	-0.001	-0.013	-0.034	-0.002	0.057	-0.018	-0.026	0.048	0.090	0.060	0.030	-0.001
4+	0.066	0.012	-0.128	-0.031	0.060	0.077	-0.077	-0.023	0.119	0.069	0.083	-0.066
Comorbidities												
Cancer	0.150	0.013	-0.162	-0.011	-0.068	0.014	-0.140	-0.049	0.073	0.037	-0.088	-0.072
Diabetes	0.077	0.012	-0.111	-0.020	0.071	0.019	-0.055	0.044	0.060	0.032	-0.024	-0.066
Heart failure	0.108	0.020	-0.138	-0.024	0.055	0.029	-0.077	-0.007	0.053	0.023	-0.053	-0.067
IHD	0.091	0.012	-0.117	-0.013	0.071	0.034	-0.128	0.021	0.069	0.035	-0.050	-0.109
Infections	0.030	0.008	-0.104	-0.027	0.117	0.040	-0.053	0.037	0.154	0.061	0.082	-0.050
Kidney failure	0.039	-0.002	-0.064	-0.027	0.036	0.036	-0.001	0.148	0.059	0.089	-0.035	-0.096
Lung disease	0.029	-0.016	-0.145	-0.027	0.219	0.129	-0.006	-0.004	0.251	0.114	0.054	-0.008
Stroke	0.094	0.008	-0.090	-0.007	0.001	-0.008	-0.071	-0.005	0.002	0.054	-0.112	-0.089
Joint surgery	-0.118	0.009	0.013	-0.011	0.191	-0.027	0.153	-0.012	0.214	0.016	0.167	0.009
VTE	0.041	0.011	-0.063	-0.012	0.010	-0.019	-0.043	-0.010	0.037	0.007	0.037	0.000

N previous biologics												
0	0.819	0.052	-0.248	-0.020	-1.168	-0.064	-1.161	-0.085	-0.814	-0.051	-1.319	-0.072
1-2	-0.686	-0.043	0.294	0.017	0.925	0.072	0.931	0.068	0.676	0.037	0.688	0.050
3+	-0.365	-0.024	-0.040	0.009	0.610	-0.003	0.587	0.043	0.372	0.033	1.309	0.050
Region												
North	0.081	0.007	-0.077	0.006	0.068	0.016	-0.146	-0.131	-0.023	0.005	-0.062	-0.017
South	0.009	0.013	0.027	0.006	0.043	-0.084	0.138	0.087	-0.223	-0.093	-0.011	0.023
Southeast	0.091	0.031	-0.049	-0.004	-0.109	-0.066	-0.113	-0.086	-0.117	-0.017	-0.008	-0.068
Stockholm	-0.161	-0.038	0.093	-0.003	0.087	0.052	-0.011	0.050	0.309	0.060	0.074	0.134
Uppsala/ Örebro	0.021	-0.011	-0.043	0.002	-0.026	0.020	0.063	0.018	0.054	0.012	-0.007	0.024
West	-0.007	0.005	0.026	-0.007	-0.069	0.064	0.009	0.014	-0.024	0.037	-0.004	-0.124

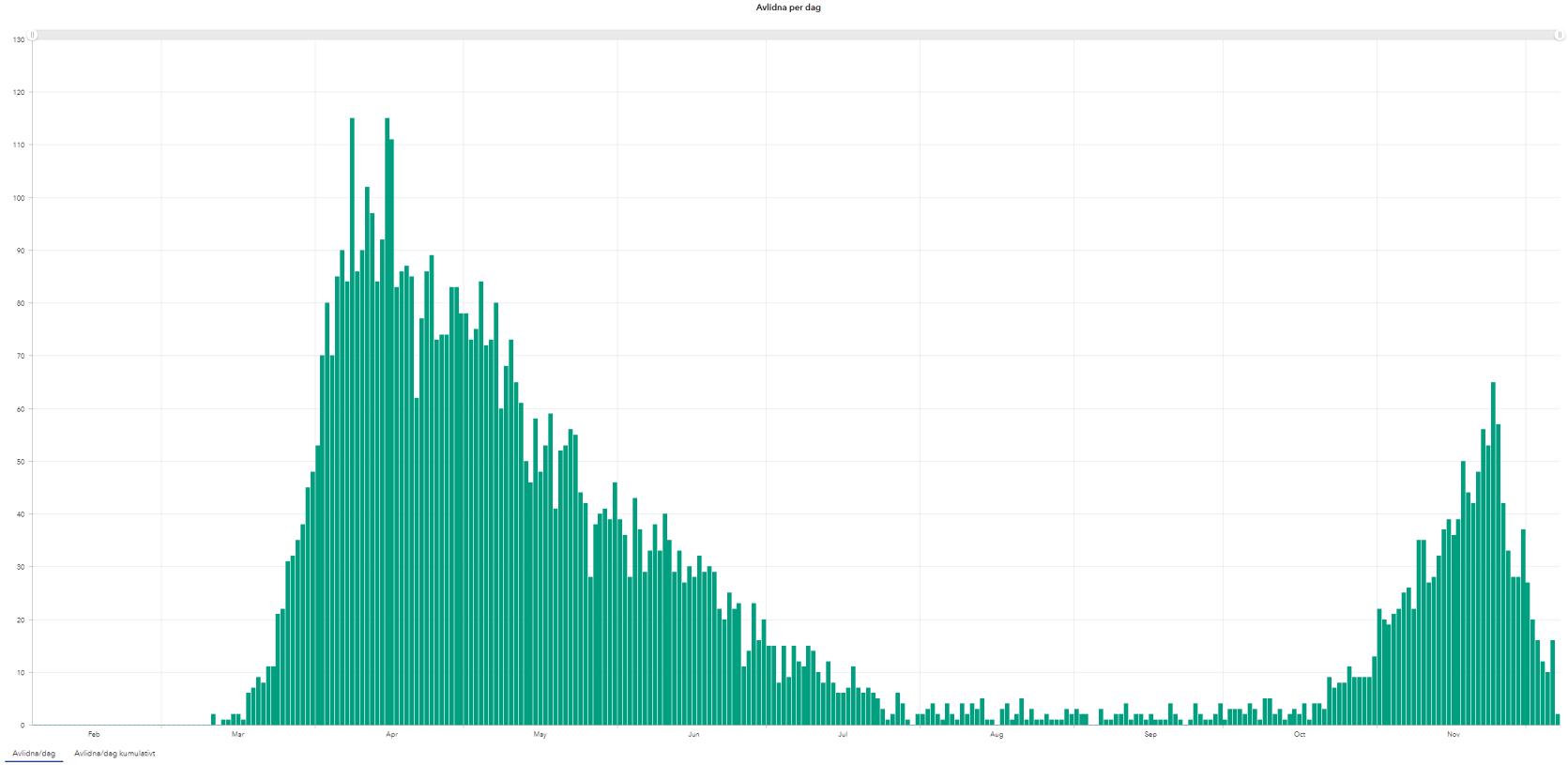
Supplementary Table 10. Standardised mean differences from propensity score weighting for all variables included in the comparison between specific DMARDs, all inflammatory joint diseases

	csDMARD		TNFi		Abatacept		Tocilizumab		Rituximab		JAKi	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Age												
<55	-0.312	-0.038	0.348	0.034	0.012	0.108	0.163	0.062	-0.083	-0.060	0.218	0.025
55-64	-0.143	-0.001	0.113	0.003	0.092	-0.051	0.108	0.051	0.023	-0.010	0.174	0.018
65-69	-0.026	-0.003	0.006	0.004	0.042	-0.005	0.022	-0.040	0.056	0.022	0.010	-0.002
70-74	0.065	0.005	-0.073	0.008	0.003	-0.062	-0.016	-0.035	0.055	0.012	-0.119	-0.020
75-79	0.148	0.003	-0.161	-0.012	-0.006	-0.011	-0.086	0.028	0.025	0.022	-0.098	0.007
80-84	0.213	0.013	-0.198	-0.023	-0.125	0.034	-0.128	0.001	-0.012	0.011	-0.153	-0.007
85+	0.268	0.046	-0.236	-0.038	-0.092	-0.023	-0.208	-0.132	-0.091	0.027	-0.187	-0.045
bDMARD previous 180 days	-0.399	-0.077	0.106	0.048	0.642	0.076	0.680	0.096	0.346	0.058	0.663	0.064
Civil status	0.017	0.001	-0.027	-0.017	-0.037	-0.028	-0.007	-0.030	0.035	0.079	0.017	0.027
Country of birth												
Sweden	0.031	0.009	-0.001	0.007	0.020	-0.047	-0.007	0.006	-0.098	0.001	-0.083	-0.071
Europe	-0.012	-0.008	-0.004	-0.009	-0.022	0.068	-0.029	-0.065	0.071	0.029	0.037	0.050
Rest of world	-0.035	-0.004	0.006	0.001	-0.003	-0.015	0.049	0.078	0.063	-0.040	0.085	0.048
DAS28												
Remission	-0.143	-0.020	0.125	0.014	-0.062	0.023	0.280	0.020	0.146	0.029	-0.066	-0.020
Low	-0.084	-0.011	0.048	0.014	0.140	0.057	-0.081	-0.036	0.137	-0.007	0.043	-0.024
Moderate	-0.193	-0.014	0.098	-0.005	0.216	0.027	-0.087	-0.010	0.234	0.050	0.322	0.044
High	-0.132	-0.008	0.009	-0.007	0.214	-0.010	0.132	0.012	0.164	0.037	0.356	0.045
Missing	0.312	0.032	-0.186	-0.013	-0.217	-0.061	-0.162	0.005	-0.376	-0.061	-0.272	-0.013
Disease duration												
<2 years	0.141	-0.023	-0.062	0.020	-0.129	0.105	-0.176	-0.050	-0.252	-0.076	-0.027	0.110
2-4 years	0.154	0.010	-0.080	-0.014	-0.080	0.029	-0.135	-0.018	-0.241	-0.020	-0.108	0.029

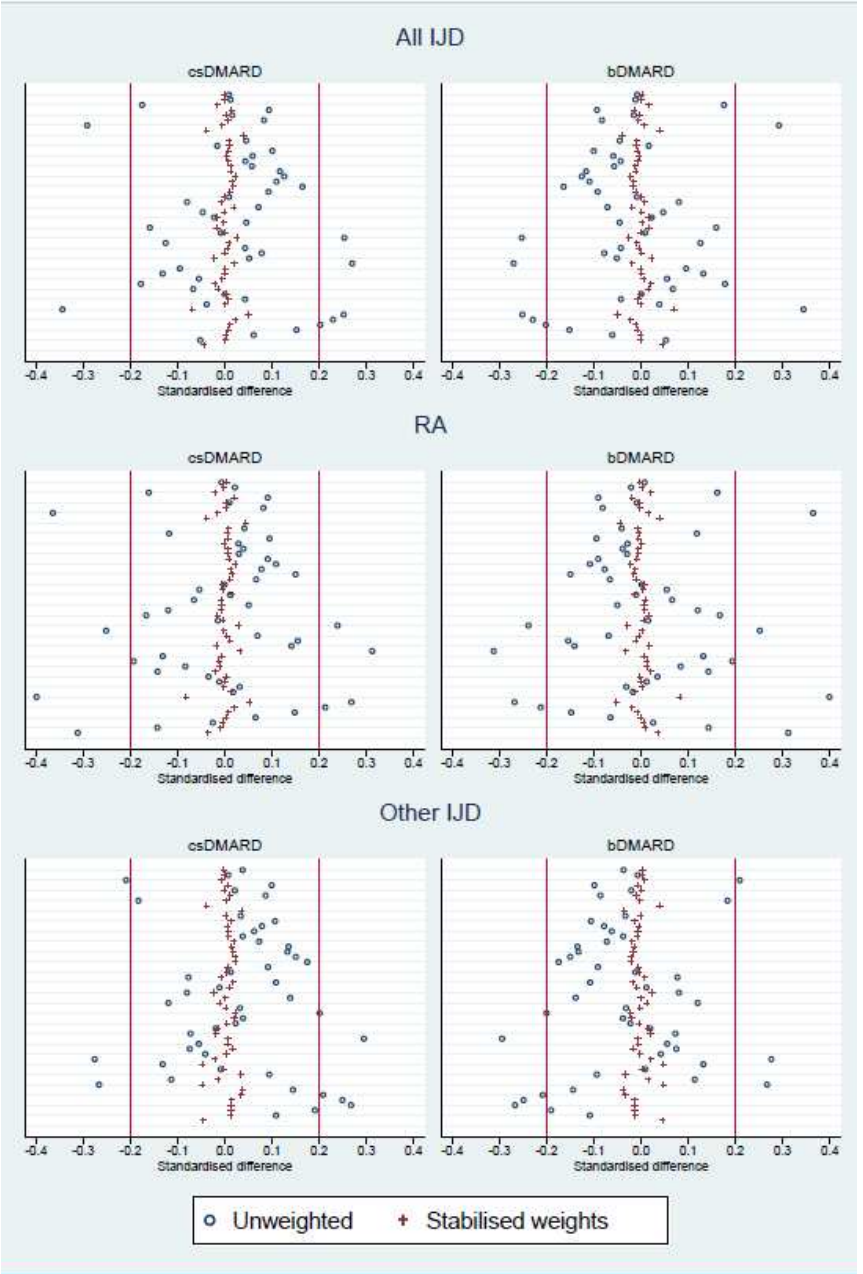
5-9 years	0.069	0.004	-0.037	-0.012	-0.086	0.002	0.008	0.024	-0.094	0.025	-0.062	-0.014
10+ years	-0.252	0.003	0.125	0.009	0.205	-0.081	0.190	0.021	0.399	0.035	0.149	-0.071
Education												
<9 years	0.239	0.025	-0.208	-0.021	-0.087	-0.049	-0.175	-0.038	-0.082	-0.014	-0.178	0.029
9-12 years	-0.015	-0.006	-0.011	0.009	0.010	0.032	0.062	0.007	0.056	-0.014	0.032	-0.022
12+ years	-0.167	-0.013	0.171	0.006	0.056	0.002	0.067	0.022	0.002	0.026	0.101	0.002
Female	-0.120	-0.024	0.053	0.005	0.155	0.067	0.141	-0.001	0.088	0.030	0.183	0.044
Hospital days (previous 10 years)												
0	0.050	0.000	0.090	0.025	-0.209	-0.049	-0.111	-0.039	-0.293	-0.107	-0.166	0.080
1-6	-0.066	-0.013	0.071	0.008	0.017	0.029	0.011	-0.010	0.005	0.007	0.032	0.020
7+	0.011	0.012	-0.160	-0.033	0.199	0.023	0.104	0.049	0.298	0.104	0.140	-0.101
Hospital days (previous year)												
0	-0.054	-0.002	0.128	0.026	-0.087	-0.052	0.081	-0.011	-0.157	-0.096	-0.088	0.055
1-3	-0.001	-0.013	-0.034	-0.002	0.057	-0.018	-0.026	0.048	0.090	0.060	0.030	-0.001
4+	0.066	0.012	-0.128	-0.031	0.060	0.077	-0.077	-0.023	0.119	0.069	0.083	-0.066
Comorbidities												
Cancer	0.150	0.013	-0.162	-0.011	-0.068	0.014	-0.140	-0.049	0.073	0.037	-0.088	-0.072
Diabetes	0.077	0.012	-0.111	-0.020	0.071	0.019	-0.055	0.044	0.060	0.032	-0.024	-0.066
Heart failure	0.108	0.020	-0.138	-0.024	0.055	0.029	-0.077	-0.007	0.053	0.023	-0.053	-0.067
IHD	0.091	0.012	-0.117	-0.013	0.071	0.034	-0.128	0.021	0.069	0.035	-0.050	-0.109
Infections	0.030	0.008	-0.104	-0.027	0.117	0.040	-0.053	0.037	0.154	0.061	0.082	-0.050
Kidney failure	0.039	-0.002	-0.064	-0.027	0.036	0.036	-0.001	0.148	0.059	0.089	-0.035	-0.096
Lung disease	0.029	-0.016	-0.145	-0.027	0.219	0.129	-0.006	-0.004	0.251	0.114	0.054	-0.008
Stroke	0.094	0.008	-0.090	-0.007	0.001	-0.008	-0.071	-0.005	0.002	0.054	-0.112	-0.089
Joint surgery	-0.118	0.009	0.013	-0.011	0.191	-0.027	0.153	-0.012	0.214	0.016	0.167	0.009
VTE	0.041	0.011	-0.063	-0.012	0.010	-0.019	-0.043	-0.010	0.037	0.007	0.037	0.000

N previous biologics												
0	0.819	0.052	-0.248	-0.020	-1.168	-0.064	-1.161	-0.085	-0.814	-0.051	-1.319	-0.072
1-2	-0.686	-0.043	0.294	0.017	0.925	0.072	0.931	0.068	0.676	0.037	0.688	0.050
3+	-0.365	-0.024	-0.040	0.009	0.610	-0.003	0.587	0.043	0.372	0.033	1.309	0.050
Region												
North	0.081	0.007	-0.077	0.006	0.068	0.016	-0.146	-0.131	-0.023	0.005	-0.062	-0.017
South	0.009	0.013	0.027	0.006	0.043	-0.084	0.138	0.087	-0.223	-0.093	-0.011	0.023
Southeast	0.091	0.031	-0.049	-0.004	-0.109	-0.066	-0.113	-0.086	-0.117	-0.017	-0.008	-0.068
Stockholm	-0.161	-0.038	0.093	-0.003	0.087	0.052	-0.011	0.050	0.309	0.060	0.074	0.134
Uppsala/ Örebro	0.021	-0.011	-0.043	0.002	-0.026	0.020	0.063	0.018	0.054	0.012	-0.007	0.024
West	-0.007	0.005	0.026	-0.007	-0.069	0.064	0.009	0.014	-0.024	0.037	-0.004	-0.124

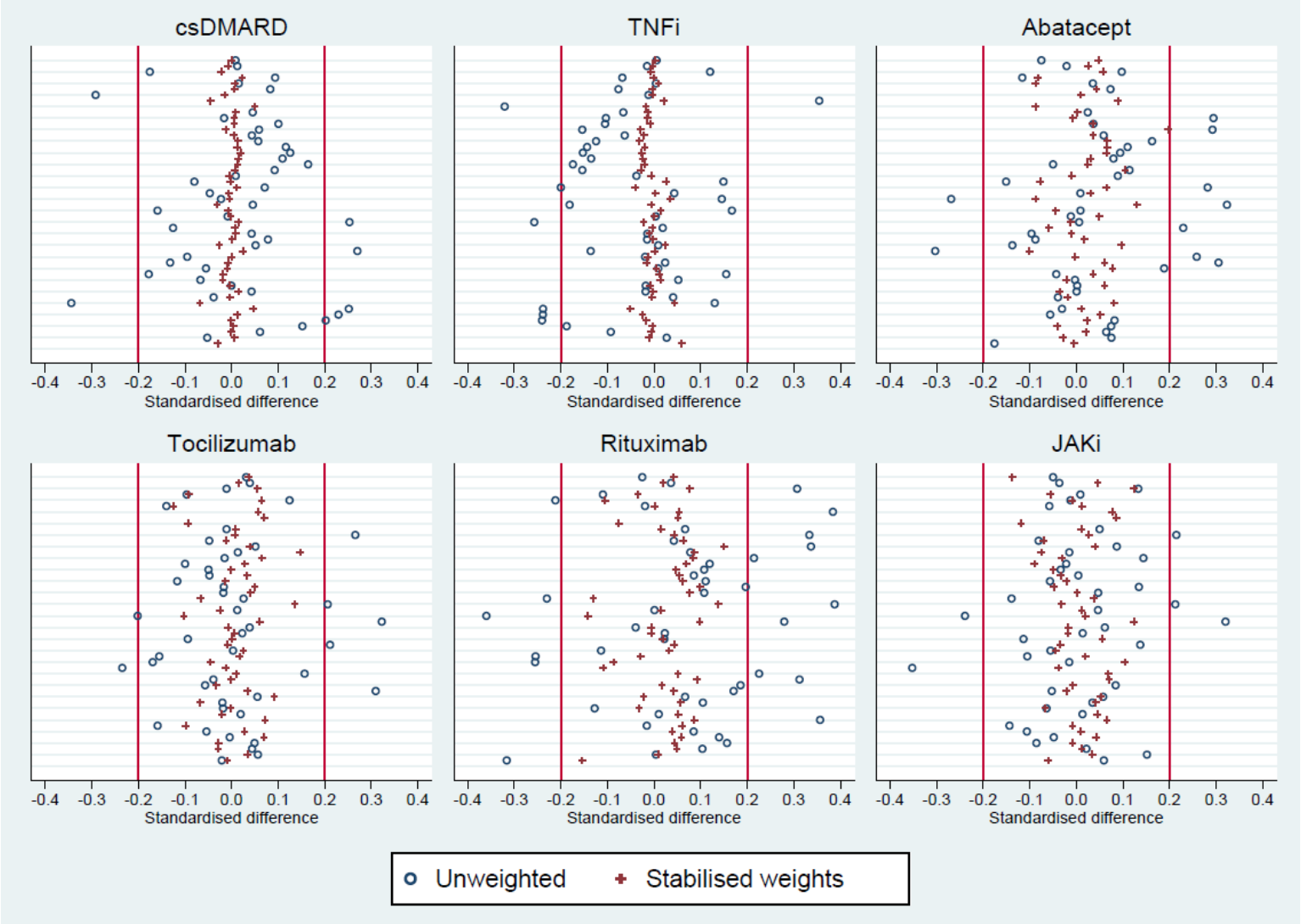
Supplementary Figure 1. Total number of deaths per day due to COVID-19 in Sweden, reported by The Public Health Agency of Sweden (Folkhälsomyndigheten, https://experience.arcgis.com/experience/09f821667ce64bf7be6f9f87457ed9aa, accessed 9th December 2020). Note that here, deaths due to COVID-19 are defined as any death that occurs within 30 days after a confirmed COVID-19 infection.



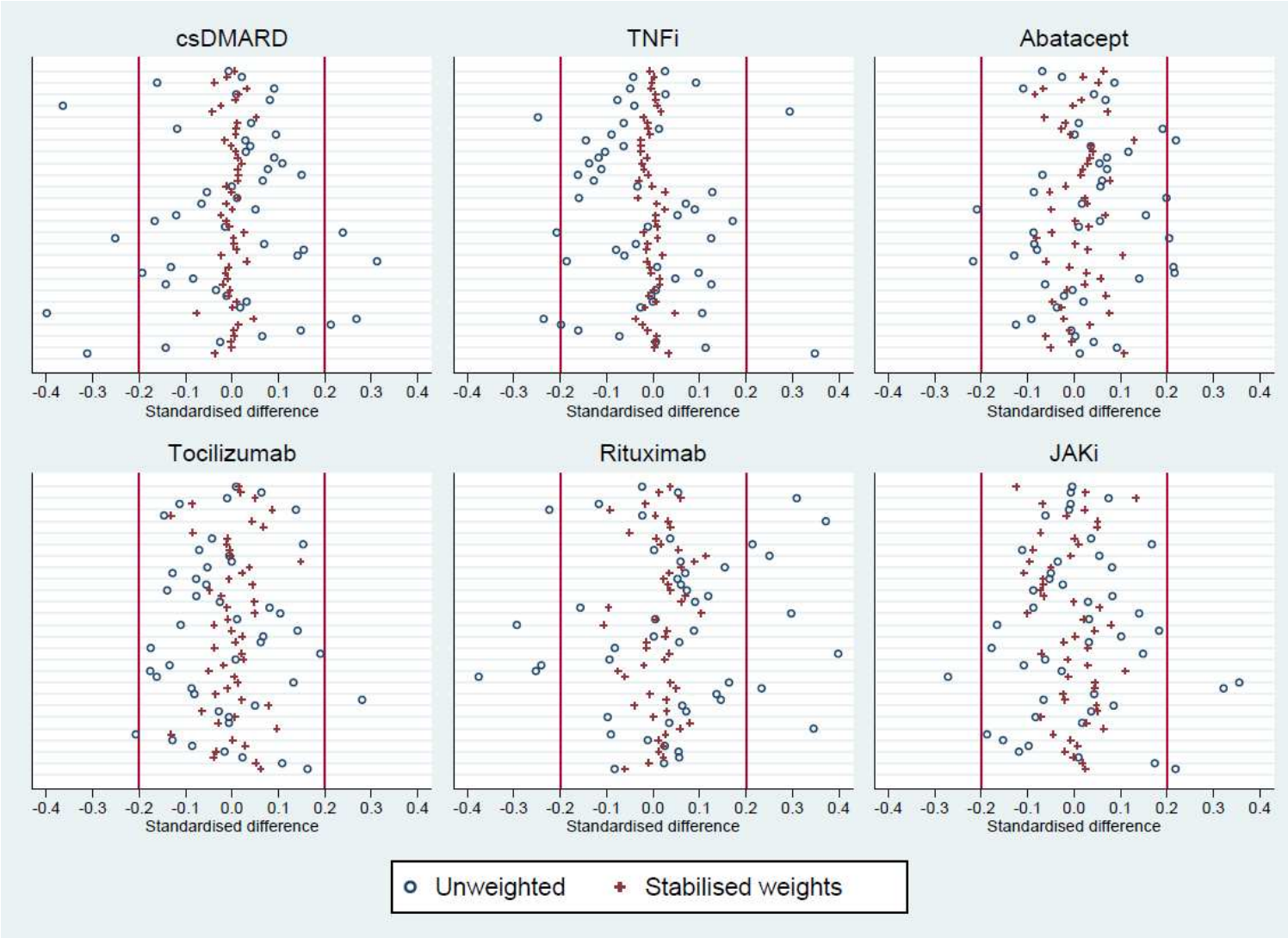
Supplementary Figure 2. Standardised mean differences from propensity score weighting for all variables included in the comparison between specific csDMARDs and bDMARDs, for all inflammatory joint diseases (IJD), RA, and other IJD.



Supplementary Figure 3. Standardised mean differences from propensity score weighting for all variables included in the comparison between DMARDs cohorts, for all patients with inflammatory joint diseases



Supplementary Figure 4. Standardised mean differences from propensity score weighting for all variables included in the comparison between DMARDs cohorts, for RA patients



Supplementary Materials

Supplementary Methods

Propensity scores were calculated for use as weights within the inverse probability weighted Cox proportional hazards models[1]. These propensity scores were estimated separately for treatment cohorts within the 1) all inflammatory joint diseases, and 2) RA cohorts. Note that due to low number of events, and balance not being achieved, between treatment cohort analyses using inverse propensity score weighting was not performed in the other IJD cohort. Propensity scores were also calculated separately when comparing the csDMARD to the b/tsDMARD groups in each of the three inflammatory joint disease cohorts.

Multinomial logistic (for the estimation of propensity scores within the six DMARD cohorts), and logistic regression models (for the estimation of propensity score within the csDMARD/b-tsDMARD cohorts) were fitted. All models contained the same covariates: history of cancer, diabetes, heart failure, ischemic heart disease, hospitalisation listing infection, lung disease, stroke, venous thromboembolic events, kidney failure, and surgery, age, sex, disease duration, DAS28, an indicator variable specifying whether the individual had received a different b/tsDMARD in the 180 days before start of follow-up, the number of previous b/tsDMARDs, days in hospital (both in the previous 10 years, and 1 year), region of domicile, educational level, civil status, and country of birth. See Supplementary Table 4 for definitions and the functional form of each of the covariates included in the propensity score model. The models additionally contained interactions between age and a history of lung disease, a history of lung disease and cancer, and age and region.

Stabilised inverse probability of treatment weights[2] were calculated from the propensity scores predicted from these models and were were additionally restricted to be no larger than the 99% and no smaller than the 1% centile of the distribution to further avoid extreme weight. The standardised mean bias[3] was used to determine whether balance had been reached when using stabilized weights; these are presented in Supplementary Tables 6-8. Subsequent Cox proportional hazards models used the robust sandwich estimator to calculate standard errors.

[1]Austin PC. The performance of different propensity score methods for estimating marginal hazard ratios. Stat. Med 2012:32(12) 2837-2849. doi: 10.1002/sim.5705

[2]Pezzi A, Cavo M, Biggeri A et al. Inverse probability weighting to estimate causal effect of a singular phase in a multiphase randomized clinical trial for multiple myeloma. BMC Medical Research Methodology 2016:16(150). doi: 10.1186/.s12874-016-0253-9

[3]Zhang Z, Kim HJ, Lonjon G et al. Balance diagnostics after propensity score matching. Ann Transl Med 2019:(1)16. doi:10.21037/atm.2018.12.10

Supplementary Analysis: Risks in patients on sulfasalazine

To assess risks for the outcomes under study specifically in patients on sulfasalazine, we have performed additional ad-hoc analyses, contrasting patients with any IJD on sulfasalazine monotherapy (N=4675) to patients on any csDMARD therapy (excluding sulfasalazine monotherapy, but including combination therapies of which sulfasalazine may form a part, N=28621), using the same analytic approach as for the other treatment comparisons.

In this select group of patients, absolute risks for the outcomes were in the same range as the other DMARD cohorts. We noted no increased risk for hospitalization for any cause (HR=1.08, 0.97-1.21, n exposed events: 381), increased point estimates for hospitalization listing COVID-19 (HR=1.52, 95% 1.05-2.20, n exposed events: 37), admission to ICU (HR=1.97 (95% CI 0.64-6.11, n exposed events: 4), but no increased risks for death from any cause (HR=0.96, 95% CI 0.70-1.31, n exposed events: 46, and no increased risks of death from COVID-19 (HR=0.97, 95% CI 0.40.2.32, n exposed events: 6).

Supplementary Table 1. Data sources included in the study

Swedish Rheumatology Quality Register (SRQ)	A nationwide longitudinal clinically integrated register operated by The Swedish Society for Rheumatology, started in 1996. Patients with RA and other rheumatologic diseases are registered in the SRQ by the treating rheumatologist. SRQ contains information about disease activity and additional information such as treatment and smoking status. SRQ covers 95% of all patients with RA treated with b/tsDMARD s in Sweden.
Swedish Patient Register (NPR)	A national register maintained by The National Board of Health and Welfare. Hospital discharges from inpatient care and patients visits in non-primary outpatient care, have been registered, since 1964 and 2001 respectively. Diagnoses are coded according to the Swedish version of the International Classification of Disease (ICD). The coverage of the inpatient part is close to 100%, for the outpatient part, the overall coverage is around 80% (higher for public than for private care-providers).
Prescribed Drug Register (PDR)	A national register maintained by The National Board of Health and Welfare. It contains information about all drugs dispensed on prescription in Sweden and is linked to the personal identification number since 2005. The coverage is close to 100%.
Swedish Population Register	A national register maintained by Swedish Tax agency. Contains information such as home district, civil status and migration data.
Longitudinal database for insurance and labor market-studies (LISA)	A national register maintained by Statistics Sweden. It contains information about sick leave, parental leave and employment status in Sweden from 1990
Cause of Death Register	The Cause of Death Register is a national register containing information on date and cause of death (underlying and contributory) for all deceased residents, including deaths among Swedish residents who died abroad. The register was started in 1952, and the data is considered complete since 1961. From that year and onward, cause of death is missing for less than 0.5% of deceased individuals, and in 2002, a validation study estimated that only 3.3% had any errors at the three digit level of the ICD-coded underlying cause of death
Swedish Intensive Care Quality Register (SIRS)	A national clinical register containing clinical information on patients admitted to intensive care from 2008 onwards. (https://www.icuregswe.org/en)

Supplementary Table 2: ICD10 and ATC codes used to define cohorts

Inflammatory joint disease cohort definitions		**DMARD treatment cohort definitions***	
Disease	**ICD10 code**	**DMARD**	**ATC code**
Rheumatoid arthritis	M05, M06	csDMARD	L04AX01, A07EC01, L04AD01, P01BA01, M01CB01, L04AA06, L04AX03, L01AA01, P01BA02, J01AA08, L04AA13, M01CC01
Psoriatic arthritis	M070, M071, M073, L405	TNFi	L04AB04, L04AB05, L04AB01, L04AB06, L04AB02
Ankylosing spondylitis	M45	Abatacept	L04AA24
Other spondyloarthropathies	M460, M461, M468, M469	Tocilizumab	L04AC07
Juvenile idiopathic arthritis	M08, M09	Rituximab	L01XC02
		JAKi	L04AA29, L04AA37, L04AA44

*As recorded in the Prescribed Drug Register

Supplementary Table3. Characteristics of Swedish residents with chronic inflammatory arthritis in Sweden March 1st, 2015-2019 combined and averaged, and their matched general population comparator subjects.

	RA	**Other IJD**	**All inflammatory joint disease**	**General population**
Average yearly individuals	52149	52127	104276	464819
Average yearly deaths	808	269	1077	2547
Age, Median (IQR)	68 (56-76)	54 (42-66)	61 (48-72)	59 (46-70)
Females	72%	51%	62%	62%
Time since diagnosis, median (IQR)	9.0 (4.0-14.0)	8.0 (4.0-13.0)	9.0 (4.0-13.0)	-
Comorbidities				
History of cancer	5%	4%	4%	4%
History of diabetes	13%	10%	11%	9%
History of heart failure	4%	2%	3%	2%
History of IHD	8%	4%	6%	3%
History of infections	7%	4%	5%	2%
History of lung diseases	11%	6%	9%	4%
History of kidney failure	3%	2%	3%	1%
History of stroke	4%	2%	3%	2%
History of joint surgery	19%	7%	13%	5%
History of VTE	1.2%	0.7%	1.0%	0.5%
Highest achieved education				
<9 years	18%	7%	13%	10%
9-12 years	55%	60%	58%	55%
12+ years	26%	33%	30%	35%
Civil status: Married	50%	48%	49%	48%
Born in Sweden (%)	88%	90%	89%	85%
Hospitalisation days past year, median (IQR)	6 (3-13)	4 (2-9)	5 (3-11)	4 (2-9)
Hospitalisation days: 10 years up to 1 year prior, median (IQR)	4 (0-14)	2 (0-7)	3 (0-10)	0 (0-5)

Supplementary Table 4: Description of covariates included in the propensity score estimation model.

Variable	**Description**
Comorbidity	
History of cancer	History of cancer recorded within 5 years prior to cohort entry. Data retrieved from the Cancer Register. Indicator variable (Y/N). Note that information on cancer diagnoses recorded in the Swedish Cancer Register was only available until December 31st 2018.
History of diabetes	History of diabetes recorded in the 10 years recorded prior to cohort entry. Defined as a record in the National Patient Register (inpatient and outpatient components, ICD10: E10-E11) or dispensation of treatment (ATC: A10) in the Prescribed Drug Register. Indicator variable (Y/N).
History of heart failure	History of heart failure recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient component, ICD10: I50). Indicator variable (Y/N).
History of ischemic heart disease.	History of ischemic heart disease recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient component, ICD10: I20-I25). Indicator variable (Y/N).
History of hospitalised infections	History of infections recorded in the 2 years prior to cohort entry. Defined as recorded in National Patient Register (inpatient component, ICD10: A00-B99, D73.3, E06.0, E32.1, G00-G02, G04.2, G05-G07, H00.0, H44.0, H60.0-H60.3, H66-H67, H70, I30.1, I40.0, J00-J22, J32, J34.0, J36, J38.3, J39.0-J39.1, J44.0, J85, J86, K04.4, K04.6, K04.7, K10.2, K11.3, K12.2, K14.0, K57.0, K57.2, K57.4, K57.8, K61, K63.0, K65.0, K65.1, K65.2, K65.9, L00-L08, L30.3, M00-M01, M46.2-M46.5, M60.0, M65.0, M71.0, M71.1, M72.6, M86, N10, N11, N12, N13.6, N15.1, N15.9, N30.0 N30.8, N34.0, N41.2, N43.1, N45.2, N45.3, N45.4, N48.2, N61, N70, N73, N75.1). Indicator variable (Y/N).
History of lung disease	History of lung disease other than infectious pneumonia recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, ICD10: J40-J94). Indicator variable (Y/N).
History of kidney failure	History of kidney failure recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, ICD10:N17-N19). Indicator variable (Y/N).
History of stroke	History of stroke recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, ICD10:I50-I69).

	Indicator variable (Y/N).
History of joint surgery	History of joint surgery recorded in the 10 years prior to cohort entry. Defined as record in National Patient Register (inpatient and outpatient components, operational codes: NGB, NFB, NBB, NHB, NHC, NHE, NHF, NHG, 8423, 8424, 8426, 8419, 8437, 8436, 8420, 8421, 8422, 8400-8415). Indicator variable (Y/N).
History of venous thrombotic event	History of VTE recorded in the 5 years recorded prior to cohort entry. Defined as record in National Patient Register (inpatient component, ICD10:I82, I26). Indicator variable (Y/N).
Health-care resource utilisation	
Hospital days in the previous year	The number of days spent in hospital during the 365 days prior to cohort entry. Data obtained from the inpatient component of the National Patient Register. Categorised into 0, 1-3, and 4+ days.
Hospital days in the previous 10 years	The number of days spent in hospital during the period 10 years to 365 days prior to cohort entry. Data obtained from the inpatient component of the National Patient Register. Categorised into 0, 1-6, and 7+ days.
Socioeconomics	
Education	Highest education achieved as recorded in the year prior to cohort entry. Data obtained from the Longitudinal integrated database for health insurance and labour market studies (LISA). Note that education information was only available to 2018 in LISA so the value in 2018 was assumed for any subsequent years. Categorised into: 1= <9 years 2=9-12years 3=12years+
Civil status	Civil status recorded in the year prior to cohort entry. Data obtained from LISA, Note that civil status information was only available to 2017 in LISA so the value in 2017 was assumed for any subsequent years. Categorised into married/partner, or single.
Country of birth	Country of birth obtained from the Total Population Register categorised as Sweden, rest of Europe, and rest of world.
Disease-related	
DAS28	DAS28 value (ESR) from most recent rheumatology visit recorded in the SRQ within one year prior to start of follow-up. Categorised into remission (<2.6), low (2.6-3.1), moderate (3.2- 5.1), high (5.2+), and missing.
Disease duration	Disease duration in years, taken as the difference between the diagnosis date (defined using the disease selection definition and data in the National Patient register) and entry to cohort. Categorised as <2, 2-4, 5-9, 10+ years.

Treatment-related	
Number of previous b/tsDMARDs	Number of previous b/tsDMARDs prior to the treatment that caused entry to cohort. Identified by combining the PDR and SRQ. Categorised as 0, 1-2, 3+.
b/tsDMARD recorded in the previous 180 days	Identifies if a different b/tsDMARD was recorded in the previous 180 days prior to start. Indicator variable (Y/N).
Concomitant steroid use*	Dispensation of steroids (ATC: H02AB06) recorded in the Prescribed Drug Register in the 90 days prior to cohort entry.
Concomitant csDMARD use*	Concomitant csDMARD use defined as dispensation of csDMARD recorded in the Prescribed Drug Register within the 120 days prior to cohort entry where the dispensation occurs after the order date of the treatment defining the exposure cohort (ATC codes: L04AX01, A07EC01, L04AD01, P01BA01, M01CB01, L04AA06, L04AX03, L01AA01, P01BA02, J01AA08, L04AA13, M01CC01)

*Variables included in weighted Cox model not propensity score estimation model

Supplementary Table 5. Characteristics of Swedish residents with chronic inflammatory joint diseases (RA, PsA, AS, SpA and JIA) according to their DMARD treatment status on March 1st 2020.

	csDMARD*	TNFi	Abatacept	Tocilizumab	Rituximab	JAKi	All b/tsDMARDs combined
Individuals	33296	22070	1324	1037	2180	1725	28336
Age at entry, median (IQR)	67 (55-75)	54 (42-66)	65 (54-73)	62 (50-72)	68 (58-75)	60 (49-69)	57 (44-68)
Female	65%	58%	79%	79%	77%	79%	62%
Time since diagnosis, median (IQR)	8.9 (4.5-14.7)	9.6 (4.8-15.5)	12.1 (6.4-17.6)	11.8 (6.8-17.4)	13.8 (8.9-18.2)	11.0 (5.7-16.9)	10.3 (5.3-16.1)
DAS28ESR at most recent visit during last 12 months (if any)							
Median (IQR)	2.6 (1.9-3.4)	2.4 (1.7-3.3)	3.1 (2.4-4.3)	1.8 (1.1-3.2)	2.9 (2.1-3.9)	3.3 (2.5-4.4)	2.5 (1.8-3.6)
Remission	52%	56%	32%	65%	43%	30%	52%
Low	19%	16%	21%	10%	18%	15%	16%
Moderate	26%	24%	36%	17%	31%	40%	27%
High	4%	4%	10%	8%	8%	15%	6%
No visit with complete DAS28 data	76%	66%	56%	59%	49%	54%	63%
N previous b/tsDMARDs (median) (IQR)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	1.0 (1.0-2.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	2.0 (1.0-3.0)	0.0 (0.0-1.0)
On other bDMARD in past 180 days (%)	1%	5%	16%	16%	10%	16%	7%
Concomitant therapies							
csDMARDs	100%	37%	42%	31%	37%	31%	37%
Steroids	22%	14%	37%	33%	31%	34%	19%
Comorbidities							

History of cancer	4%	1%	2%	1%	5%	2%	2%
History of diabetes	14%	9%	15%	11%	15%	12%	10%
History of heart failure	4%	1%	4%	2%	4%	2%	2%
History of IHD	6%	3%	7%	3%	8%	5%	4%
History of infections	6%	3%	9%	5%	10%	8%	4%
History of lung diseases	9%	6%	16%	10%	17%	11%	8%
History of kidney failure	3%	2%	3%	3%	3%	2%	2%
History of stroke	4%	2%	3%	2%	3%	2%	2%
History of joint surgery	14%	12%	25%	24%	26%	22%	15%
History of VTE	1%	1%	1%	1%	2%	1%	1%
Highest acheived education							
<9 years	14%	5%	11%	8%	11%	7%	6%
9-12 years	59%	59%	58%	60%	60%	59%	59%
12+ years	27%	36%	31%	32%	29%	33%	35%
Civil status, married	51%	49%	52%	49%	50%	49%	49%
Born in Sweden	89%	88%	88%	88%	84%	86%	88%
N hospitalisation days in past 365 days**, median (IQR)	5.0 (3.0-11.0)	4.0 (2.0-7.0)	5.0 (3.0-12.0)	4.0 (3.0-7.0)	5.0 (3.0-11.0)	5.0 (3.0-12.0)	4.0 (2.0-8.0)
N hospitalisation days the 10 years prior, up to 1 year prior**, median (IQR)	2.0 (0.0-9.0)	2.0 (0.0-6.0)	5.0 (0.0-14.0)	4.0 (0.0-12.0)	6.0 (1.0-18.0)	4.0 (0.0-13.0)	2.0 (0.0-8.0)

*Defined as methotrexate, sulfasalazine, anti-malarials, and leflunomide. ** of those with a hospitalisation

Supplementary Table 6. Characteristics of Swedish residents with chronic inflammatory joint diseases (RA only) according to their DMARD treatment status on March 1st 2020.

	csDMARD*	TNFi	Abatacept	Tocilizumab	Rituximab	JAKi	All b/tsDMARDs combined
Individuals	22904	10463	1221	942	2150	1384	16160
Age at entry (median), IQR	70 (60-77)	62 (51-71)	66 (56-74)	63 (53-72)	68 (58-75)	62 (52-71)	64 (52-72)
Female	71%	75%	80%	79%	77%	81%	76%
Time since diagnosis, median (IQR)	8.9 (4.4-14.8)	11.1 (5.9-16.7)	12.2 (6.6-17.7)	12.0 (6.9-17.5)	13.8 (9.0-18.3)	11.7 (6.2-17.4)	11.6 (6.4-17.1)
DAS28ESR at most recent visit during last 12 months (if any)							
Median (IQR)	2.6 (1.9-3.4)	2.6 (1.9-3.6)	3.0 (2.4-4.3)	1.9 (1.1-3.3)	2.9 (2.1-3.9)	3.3 (2.5-4.4)	2.7 (2.0-3.8)
Remission	51%	49%	33%	64%	43%	31%	46%
Low	19%	17%	21%	10%	18%	15%	17%
Moderate	26%	29%	36%	17%	32%	40%	30%
High	4%	5%	11%	9%	8%	14%	7%
No. visit with complete DAS28 data	72%	59%	56%	58%	49%	53%	57%
N previous b/tsDMARDs (median) (IQR)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	2.0 (1.0-3.0)	0.0 (0.0-1.0)
On other bDMARD in past 180 days (%)	1%	5%	16%	16%	10%	16%	8%
Concomitant therapies							
csDMARDs	100%	51%	43%	31%	37%	32%	46%
Steroids	26%	21%	38%	33%	31%	36%	26%
Comorbidities							

History of cancer	5%	1%	2%	1%	5%	2%	2%
History of diabetes	14%	10%	15%	11%	15%	12%	11%
History of heart failure	4%	2%	4%	2%	4%	2%	2%
History of IHD	7%	4%	8%	3%	8%	5%	5%
History of infections	6%	4%	9%	5%	10%	8%	6%
History of lung diseases	11%	7%	17%	10%	17%	12%	10%
History of kidney failure	3%	2%	3%	3%	3%	2%	2%
History of stroke	4%	2%	4%	2%	4%	2%	2%
History of joint surgery	16%	19%	25%	24%	26%	25%	21%
History of VTE	1%	1%	1%	1%	2%	2%	1%
Highest acheived education							
<9 years	18%	9%	11%	8%	11%	8%	9%
9-12 years	57%	57%	58%	60%	60%	59%	57%
12+ years	26%	35%	31%	32%	29%	33%	33%
Civil status, married	51%	52%	53%	52%	50%	50%	52%
Born in Sweden	88%	87%	88%	87%	84%	85%	87%
N hospitalisation days in past 365 days**, median (IQR)	5.0 (3.0-11.0)	4.0 (2.0-8.0)	5.0 (3.0-12.0)	4.0 (3.0-7.0)	5.0 (3.0-11.0)	5.0 (3.0-11.0)	5.0 (3.0-9.0)
N hospitalisation days the 10 years prior, up to 1 year prior**, median (IQR)	3.0 (0.0-10.0)	2.0 (0.0-7.0)	5.0 (0.0-15.0)	4.0 (0.0-12.0)	6.0 (1.0-18.0)	4.0 (0.0-13.0)	3.0 (0.0-10.0)

*Defined as methotrexate, sulfasalazine, anti-malarials, and leflunomide. ** of those with a hospitalization

Supplementary Table 7. Characteristics of Swedish residents with chronic inflammatory joint diseases (PsA, AS,SpA and JIA only) according to their DMARD treatment status on March 1st 2020.

	csDMARD*	TNFi	Abatacept	Tocilizumab	Rituximab	JAKi	All b/tsDMARDs combined
Individuals	10392	11607	103	95	30	341	12176
Age at entry (median), IQR	59 (47-69)	48 (37-58)	47 (29-58)	30 (24-56)	47 (27-62)	51 (37-60)	48 (36-58)
Female	51%	43%	71%	78%	80%	70%	44%
Time since diagnosis, median (IQR)	8.9 (4.7-14.4)	8.4 (4.1-14.1)	9.3 (4.6-15.5)	9.2 (5.6-16.8)	10.2 (6.2-15.1)	8.1 (4.3-14.7)	8.4 (4.1-14.1)
DAS28ESR at most recent visit during last 12 months (if any)							
Median (IQR)	2.5 (1.8-3.3)	2.1 (1.5-3.0)	3.2 (2.5-4.1)	1.0 (0.8-2.2)	4.8 (2.2-5.3)	3.4 (2.6-4.8)	2.2 (1.5-3.1)
Remission	54%	66%	28%	83%	33%	28%	64%
Low	19%	14%	21%	3%	11%	15%	14%
Moderate	25%	18%	46%	14%	22%	39%	20%
High	3%	3%	5%	0%	33%	18%	3%
No visit with complete DAS28 data	84%	72%	62%	69%	70%	57%	71%
N previous b/tsDMARDs (median) (IQR)	0.0 (0.0-0.0)	0.0 (0.0-1.0)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	1.0 (1.0-3.0)	2.0 (1.0-3.0)	0.0 (0.0-1.0)
On other bDMARD in past 180 days (%)	1%	5%	22%	15%	23%	15%	6%
Concomitant therapies							
csDMARDs	100%	25%	26%	22%	23%	28%	25%
Steroids	11%	8%	27%	28%	23%	30%	9%
Comorbidities							

History of cancer	3%	1%	0%	1%	3%	2%	1%
History of diabetes	13%	8%	8%	5%	13%	13%	9%
History of heart failure	2%	1%	1%	0%	3%	1%	1%
History of IHD	5%	2%	4%	1%	3%	3%	2%
History of infections	4%	2%	5%	3%	7%	9%	3%
History of lung diseases	6%	4%	13%	7%	20%	6%	5%
History of kidney failure	2%	2%	4%	2%	3%	2%	2%
History of stroke	2%	1%	2%	0%	0%	1%	1%
History of joint surgery	10%	6%	17%	21%	13%	11%	7%
History of VTE	1%	0%	0%	2%	3%	1%	0%
Highest acheived education							
<9 years	7%	2%	6%	3%		3%	3%
9-12 years	63%	61%	66%	58%	70%	63%	61%
12+ years	31%	37%	28%	39%	30%	34%	37%
Civil status, married	51%	46%	39%	24%	43%	45%	45%
Born in Sweden	92%	89%	92%	94%	90%	93%	89%
N hospitalisation days in past 365 days**, median (IQR)	4.0 (2.0-8.0)	3.0 (2.0-6.0)	2.0 (2.0-6.0)	5.0 (3.0-6.0)	10.0 (2.0-46.0)	4.0 (3.0-19.0)	3.0 (2.0-6.0)
N hospitalisation days the 10 years prior, up to 1 year prior**, median (IQR)	2.0 (0.0-7.0)	0.0 (0.0-5.0)	4.0 (0.0-9.0)	5.0 (2.0-13.0)	5.0 (2.0-11.0)	4.0 (0.0-11.0)	0.0 (0.0-5.0)

*Defined as methotrexate, sulfasalazine, anti-malarials, and leflunomide. ** of those with a hospitalisation

Supplementary Table 8: Standardised mean differences from propensity score weighting for all variables included in the csDMARD vs. b/tsDMARD analyses.

	All inflammatory diseases				RA				Other IJD			
	csDMARD		b/tsDMARD		csDMARD		b/tsDMARD		csDMARD		b/tsDMARD	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Age												
<55	-0.453	-0.045	0.453	0.045	-0.312	-0.035	0.312	0.035	-0.528	-0.046	0.528	0.046
55-64	-0.052	0.000	0.052	0.000	-0.143	-0.009	0.143	0.009	0.108	0.012	-0.108	-0.012
65-69	0.061	0.001	-0.061	-0.001	-0.026	-0.005	0.026	0.005	0.191	0.013	-0.191	-0.013
70-74	0.152	0.008	-0.152	-0.008	0.065	0.001	-0.065	-0.001	0.267	0.013	-0.267	-0.013
75-79	0.202	0.011	-0.202	-0.011	0.148	0.007	-0.148	-0.007	0.249	0.014	-0.249	-0.014
80-84	0.229	0.022	-0.229	-0.022	0.213	0.019	-0.213	-0.019	0.208	0.033	-0.208	-0.033
85+	0.252	0.050	-0.252	-0.050	0.268	0.052	-0.268	-0.052	0.144	0.037	-0.144	-0.037
bDMARD previous 180 days	-0.344	-0.069	0.344	0.069	-0.399	-0.083	0.399	0.083	-0.267	-0.048	0.267	0.048
Civil status	-0.039	0.001	0.039	-0.001	0.017	0.012	-0.017	-0.012	-0.114	-0.015	0.114	0.015
Country of birth												
Sweden	0.043	0.007	-0.043	-0.007	0.031	-0.002	-0.031	0.002	0.094	0.034	-0.094	-0.034
Europe	0.000	0.003	0.000	-0.003	-0.012	0.001	0.012	-0.001	-0.009	-0.003	0.009	0.003
Rest of world	-0.067	-0.015	0.067	0.015	-0.035	0.003	0.035	-0.003	-0.132	-0.048	0.132	0.048
DAS28												
Remission	-0.178	-0.021	0.178	0.021	-0.143	-0.021	0.143	0.021	-0.276	-0.021	0.276	0.021
Low	-0.055	-0.006	0.055	0.006	-0.084	-0.012	0.084	0.012	-0.042	0.003	0.042	-0.003
Moderate	-0.132	-0.001	0.132	0.001	-0.193	-0.012	0.193	0.012	-0.074	0.017	0.074	-0.017
High	-0.095	0.001	0.095	-0.001	-0.132	-0.007	0.132	0.007	-0.055	0.006	0.055	-0.006
Missing	0.270	0.019	-0.270	-0.019	0.312	0.032	-0.312	-0.032	0.294	0.006	-0.294	-0.006

Disease duration												
<2 years	0.051	-0.022	-0.051	0.022	0.141	-0.017	-0.141	0.017	-0.073	-0.020	0.073	0.020
2-4 years	0.078	0.000	-0.078	0.000	0.154	0.011	-0.154	-0.011	-0.019	-0.015	0.019	0.015
5-9 years	0.043	0.005	-0.043	-0.005	0.069	0.005	-0.069	-0.005	0.023	0.004	-0.023	-0.004
10+ years	-0.126	0.009	0.126	-0.009	-0.252	-0.002	0.252	0.002	0.039	0.020	-0.039	-0.020
Education												
<9 years	0.253	0.025	-0.253	-0.025	0.239	0.029	-0.239	-0.029	0.201	0.022	-0.201	-0.022
9-12 years	-0.009	0.000	0.009	0.000	-0.015	-0.005	0.015	0.005	0.032	0.002	-0.032	-0.002
12+ years	-0.159	-0.017	0.159	0.017	-0.167	-0.016	0.167	0.016	-0.120	-0.012	0.120	0.012
Female	0.045	-0.002	-0.045	0.002	-0.120	-0.008	0.120	0.008	0.138	0.000	-0.138	0.000
Hospital days (prev 10 years)												
0	-0.023	-0.016	0.023	0.016	0.050	-0.007	-0.050	0.007	-0.080	-0.024	0.080	0.024
1-6	-0.047	-0.001	0.047	0.001	-0.066	-0.008	0.066	0.008	-0.011	0.009	0.011	-0.009
7+	0.071	0.019	-0.071	-0.019	0.011	0.015	-0.011	-0.015	0.108	0.018	-0.108	-0.018
Hospital days (previous year)												
0	-0.080	-0.008	0.080	0.008	-0.054	-0.004	0.054	0.004	-0.077	-0.008	0.077	0.008
1-3	0.009	-0.001	-0.009	0.001	-0.001	-0.006	0.001	0.006	0.012	0.004	-0.012	-0.004
4+	0.092	0.011	-0.092	-0.011	0.066	0.010	-0.066	-0.010	0.091	0.006	-0.091	-0.006
Comorbiditie s												
Cancer	0.164	0.017	-0.164	-0.017	0.150	0.015	-0.150	-0.015	0.174	0.021	-0.174	-0.021
Diabetes	0.109	0.015	-0.109	-0.015	0.077	0.012	-0.077	-0.012	0.150	0.021	-0.150	-0.021
Heart failure	0.126	0.022	-0.126	-0.022	0.108	0.022	-0.108	-0.022	0.132	0.017	-0.132	-0.017
IHD	0.116	0.012	-0.116	-0.012	0.091	0.009	-0.091	-0.009	0.135	0.014	-0.135	-0.014

Infections	0.057	0.013	-0.057	-0.013	0.030	0.006	-0.030	-0.006	0.073	0.019	-0.073	-0.019
Kidney failure	0.043	0.007	-0.043	-0.007	0.039	0.006	-0.039	-0.006	0.038	0.008	-0.038	-0.008
Lung disease	0.059	0.004	-0.059	-0.004	0.029	-0.001	-0.029	0.001	0.062	0.007	-0.062	-0.007
Stroke	0.100	0.007	-0.100	-0.007	0.094	0.006	-0.094	-0.006	0.078	0.005	-0.078	-0.005
Joint surgery	-0.016	0.010	0.016	-0.010	-0.118	0.005	0.118	-0.005	0.106	0.013	-0.106	-0.013
VTE	0.045	0.008	-0.045	-0.008	0.041	0.007	-0.041	-0.007	0.033	0.002	-0.033	-0.002
N previous biologics												
0	0.721	0.040	-0.721	-0.040	0.819	0.045	-0.819	-0.045	0.574	0.036	-0.574	-0.036
1-2	-0.620	-0.039	0.620	0.039	-0.686	-0.040	0.686	0.040	-0.518	-0.039	0.518	0.039
3+	-0.292	-0.007	0.292	0.007	-0.365	-0.016	0.365	0.016	-0.183	0.003	0.183	-0.003
Region												
North	0.083	0.006	-0.083	-0.006	0.081	0.002	-0.081	-0.002	0.086	0.010	-0.086	-0.010
South	0.015	0.003	-0.015	-0.003	0.009	0.003	-0.009	-0.003	0.021	-0.001	-0.021	0.001
Southeast	0.093	0.014	-0.093	-0.014	0.091	0.020	-0.091	-0.020	0.099	0.006	-0.099	-0.006
Stockholm	-0.176	-0.016	0.176	0.016	-0.161	-0.021	0.161	0.021	-0.209	-0.007	0.209	0.007
Uppsala/ Örebro	0.012	-0.001	-0.012	0.001	0.021	-0.003	-0.021	0.003	0.007	-0.002	-0.007	0.002
West	0.008	-0.002	-0.008	0.002	-0.007	0.003	0.007	-0.003	0.037	-0.003	-0.037	0.003

Supplementary Table 9: Standardised mean differences from propensity score weighting for all variables included in the treatment comparison between specific DMARDs, RA only

	csDMARD		TNFi		Abatacept		Tocilizumab		Rituximab		JAKi	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Age												
<55	-0.312	-0.038	0.348	0.034	0.012	0.108	0.163	0.062	-0.083	-0.060	0.218	0.025
55-64	-0.143	-0.001	0.113	0.003	0.092	-0.051	0.108	0.051	0.023	-0.010	0.174	0.018
65-69	-0.026	-0.003	0.006	0.004	0.042	-0.005	0.022	-0.040	0.056	0.022	0.010	-0.002
70-74	0.065	0.005	-0.073	0.008	0.003	-0.062	-0.016	-0.035	0.055	0.012	-0.119	-0.020
75-79	0.148	0.003	-0.161	-0.012	-0.006	-0.011	-0.086	0.028	0.025	0.022	-0.098	0.007
80-84	0.213	0.013	-0.198	-0.023	-0.125	0.034	-0.128	0.001	-0.012	0.011	-0.153	-0.007
85+	0.268	0.046	-0.236	-0.038	-0.092	-0.023	-0.208	-0.132	-0.091	0.027	-0.187	-0.045
bDMARD previous 180 days	-0.399	-0.077	0.106	0.048	0.642	0.076	0.680	0.096	0.346	0.058	0.663	0.064
Civil status	0.017	0.001	-0.027	-0.017	-0.037	-0.028	-0.007	-0.030	0.035	0.079	0.017	0.027
Country of birth												
Sweden	0.031	0.009	-0.001	0.007	0.020	-0.047	-0.007	0.006	-0.098	0.001	-0.083	-0.071
Europe	-0.012	-0.008	-0.004	-0.009	-0.022	0.068	-0.029	-0.065	0.071	0.029	0.037	0.050
Rest of world	-0.035	-0.004	0.006	0.001	-0.003	-0.015	0.049	0.078	0.063	-0.040	0.085	0.048
DAS28												
Remission	-0.143	-0.020	0.125	0.014	-0.062	0.023	0.280	0.020	0.146	0.029	-0.066	-0.020
Low	-0.084	-0.011	0.048	0.014	0.140	0.057	-0.081	-0.036	0.137	-0.007	0.043	-0.024
Moderate	-0.193	-0.014	0.098	-0.005	0.216	0.027	-0.087	-0.010	0.234	0.050	0.322	0.044
High	-0.132	-0.008	0.009	-0.007	0.214	-0.010	0.132	0.012	0.164	0.037	0.356	0.045
Missing	0.312	0.032	-0.186	-0.013	-0.217	-0.061	-0.162	0.005	-0.376	-0.061	-0.272	-0.013
Disease duration												
<2 years	0.141	-0.023	-0.062	0.020	-0.129	0.105	-0.176	-0.050	-0.252	-0.076	-0.027	0.110
2-4 years	0.154	0.010	-0.080	-0.014	-0.080	0.029	-0.135	-0.018	-0.241	-0.020	-0.108	0.029

5-9 years	0.069	0.004	-0.037	-0.012	-0.086	0.002	0.008	0.024	-0.094	0.025	-0.062	-0.014
10+ years	-0.252	0.003	0.125	0.009	0.205	-0.081	0.190	0.021	0.399	0.035	0.149	-0.071
Education												
<9 years	0.239	0.025	-0.208	-0.021	-0.087	-0.049	-0.175	-0.038	-0.082	-0.014	-0.178	0.029
9-12 years	-0.015	-0.006	-0.011	0.009	0.010	0.032	0.062	0.007	0.056	-0.014	0.032	-0.022
12+ years	-0.167	-0.013	0.171	0.006	0.056	0.002	0.067	0.022	0.002	0.026	0.101	0.002
Female	-0.120	-0.024	0.053	0.005	0.155	0.067	0.141	-0.001	0.088	0.030	0.183	0.044
Hospital days (previous 10 years)												
0	0.050	0.000	0.090	0.025	-0.209	-0.049	-0.111	-0.039	-0.293	-0.107	-0.166	0.080
1-6	-0.066	-0.013	0.071	0.008	0.017	0.029	0.011	-0.010	0.005	0.007	0.032	0.020
7+	0.011	0.012	-0.160	-0.033	0.199	0.023	0.104	0.049	0.298	0.104	0.140	-0.101
Hospital days (previous year)												
0	-0.054	-0.002	0.128	0.026	-0.087	-0.052	0.081	-0.011	-0.157	-0.096	-0.088	0.055
1-3	-0.001	-0.013	-0.034	-0.002	0.057	-0.018	-0.026	0.048	0.090	0.060	0.030	-0.001
4+	0.066	0.012	-0.128	-0.031	0.060	0.077	-0.077	-0.023	0.119	0.069	0.083	-0.066
Comorbidities												
Cancer	0.150	0.013	-0.162	-0.011	-0.068	0.014	-0.140	-0.049	0.073	0.037	-0.088	-0.072
Diabetes	0.077	0.012	-0.111	-0.020	0.071	0.019	-0.055	0.044	0.060	0.032	-0.024	-0.066
Heart failure	0.108	0.020	-0.138	-0.024	0.055	0.029	-0.077	-0.007	0.053	0.023	-0.053	-0.067
IHD	0.091	0.012	-0.117	-0.013	0.071	0.034	-0.128	0.021	0.069	0.035	-0.050	-0.109
Infections	0.030	0.008	-0.104	-0.027	0.117	0.040	-0.053	0.037	0.154	0.061	0.082	-0.050
Kidney failure	0.039	-0.002	-0.064	-0.027	0.036	0.036	-0.001	0.148	0.059	0.089	-0.035	-0.096
Lung disease	0.029	-0.016	-0.145	-0.027	0.219	0.129	-0.006	-0.004	0.251	0.114	0.054	-0.008
Stroke	0.094	0.008	-0.090	-0.007	0.001	-0.008	-0.071	-0.005	0.002	0.054	-0.112	-0.089
Joint surgery	-0.118	0.009	0.013	-0.011	0.191	-0.027	0.153	-0.012	0.214	0.016	0.167	0.009
VTE	0.041	0.011	-0.063	-0.012	0.010	-0.019	-0.043	-0.010	0.037	0.007	0.037	0.000

N previous biologics												
0	0.819	0.052	-0.248	-0.020	-1.168	-0.064	-1.161	-0.085	-0.814	-0.051	-1.319	-0.072
1-2	-0.686	-0.043	0.294	0.017	0.925	0.072	0.931	0.068	0.676	0.037	0.688	0.050
3+	-0.365	-0.024	-0.040	0.009	0.610	-0.003	0.587	0.043	0.372	0.033	1.309	0.050
Region												
North	0.081	0.007	-0.077	0.006	0.068	0.016	-0.146	-0.131	-0.023	0.005	-0.062	-0.017
South	0.009	0.013	0.027	0.006	0.043	-0.084	0.138	0.087	-0.223	-0.093	-0.011	0.023
Southeast	0.091	0.031	-0.049	-0.004	-0.109	-0.066	-0.113	-0.086	-0.117	-0.017	-0.008	-0.068
Stockholm	-0.161	-0.038	0.093	-0.003	0.087	0.052	-0.011	0.050	0.309	0.060	0.074	0.134
Uppsala/ Örebro	0.021	-0.011	-0.043	0.002	-0.026	0.020	0.063	0.018	0.054	0.012	-0.007	0.024
West	-0.007	0.005	0.026	-0.007	-0.069	0.064	0.009	0.014	-0.024	0.037	-0.004	-0.124

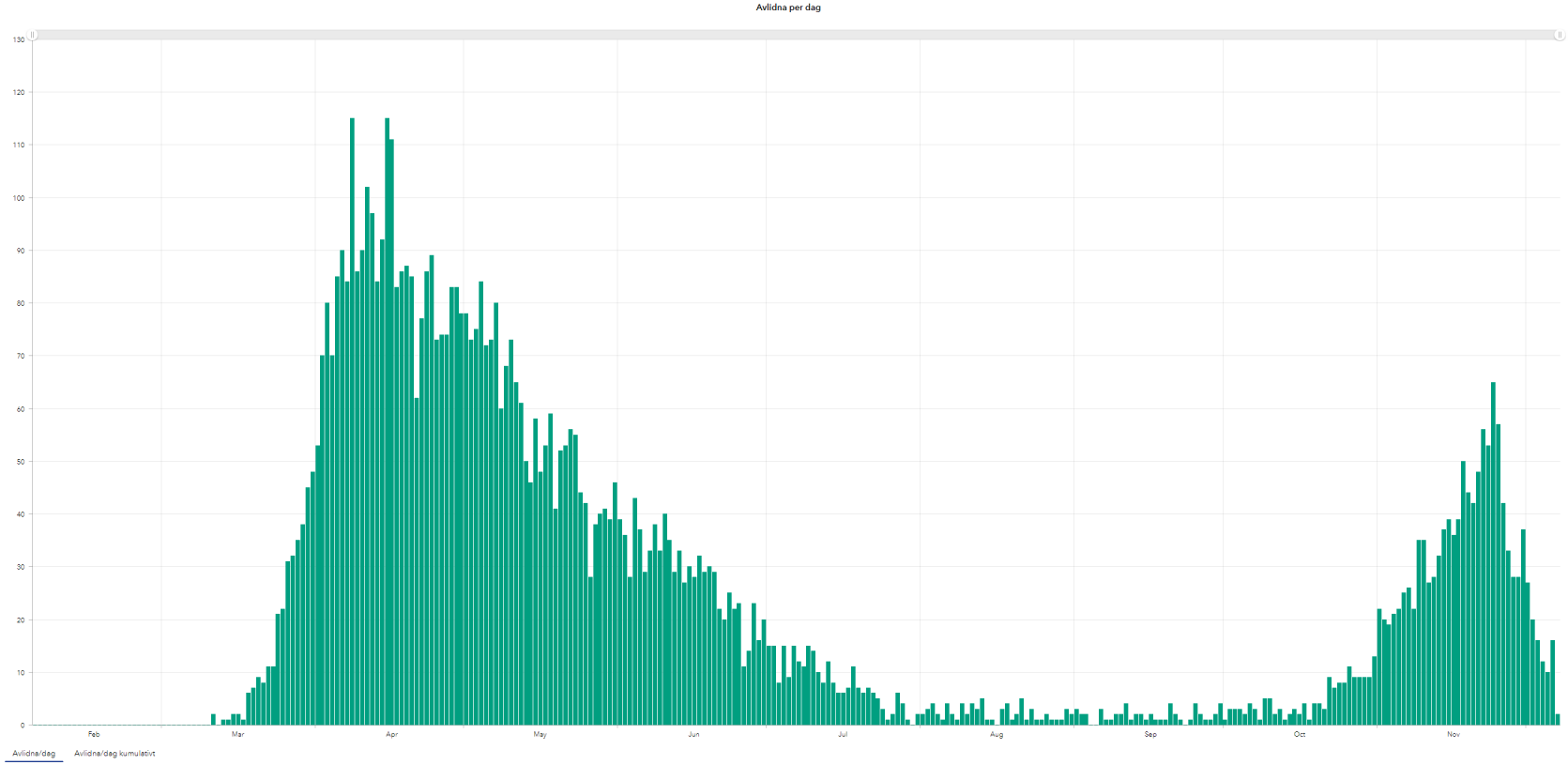
Supplementary Table 10. Standardised mean differences from propensity score weighting for all variables included in the comparison between specific DMARDs, all inflammatory joint diseases

	csDMARD		TNFi		Abatacept		Tocilizumab		Rituximab		JAKi	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Age												
<55	-0.312	-0.038	0.348	0.034	0.012	0.108	0.163	0.062	-0.083	-0.060	0.218	0.025
55-64	-0.143	-0.001	0.113	0.003	0.092	-0.051	0.108	0.051	0.023	-0.010	0.174	0.018
65-69	-0.026	-0.003	0.006	0.004	0.042	-0.005	0.022	-0.040	0.056	0.022	0.010	-0.002
70-74	0.065	0.005	-0.073	0.008	0.003	-0.062	-0.016	-0.035	0.055	0.012	-0.119	-0.020
75-79	0.148	0.003	-0.161	-0.012	-0.006	-0.011	-0.086	0.028	0.025	0.022	-0.098	0.007
80-84	0.213	0.013	-0.198	-0.023	-0.125	0.034	-0.128	0.001	-0.012	0.011	-0.153	-0.007
85+	0.268	0.046	-0.236	-0.038	-0.092	-0.023	-0.208	-0.132	-0.091	0.027	-0.187	-0.045
bDMARD previous 180 days	-0.399	-0.077	0.106	0.048	0.642	0.076	0.680	0.096	0.346	0.058	0.663	0.064
Civil status	0.017	0.001	-0.027	-0.017	-0.037	-0.028	-0.007	-0.030	0.035	0.079	0.017	0.027
Country of birth												
Sweden	0.031	0.009	-0.001	0.007	0.020	-0.047	-0.007	0.006	-0.098	0.001	-0.083	-0.071
Europe	-0.012	-0.008	-0.004	-0.009	-0.022	0.068	-0.029	-0.065	0.071	0.029	0.037	0.050
Rest of world	-0.035	-0.004	0.006	0.001	-0.003	-0.015	0.049	0.078	0.063	-0.040	0.085	0.048
DAS28												
Remission	-0.143	-0.020	0.125	0.014	-0.062	0.023	0.280	0.020	0.146	0.029	-0.066	-0.020
Low	-0.084	-0.011	0.048	0.014	0.140	0.057	-0.081	-0.036	0.137	-0.007	0.043	-0.024
Moderate	-0.193	-0.014	0.098	-0.005	0.216	0.027	-0.087	-0.010	0.234	0.050	0.322	0.044
High	-0.132	-0.008	0.009	-0.007	0.214	-0.010	0.132	0.012	0.164	0.037	0.356	0.045
Missing	0.312	0.032	-0.186	-0.013	-0.217	-0.061	-0.162	0.005	-0.376	-0.061	-0.272	-0.013
Disease duration												
<2 years	0.141	-0.023	-0.062	0.020	-0.129	0.105	-0.176	-0.050	-0.252	-0.076	-0.027	0.110
2-4 years	0.154	0.010	-0.080	-0.014	-0.080	0.029	-0.135	-0.018	-0.241	-0.020	-0.108	0.029

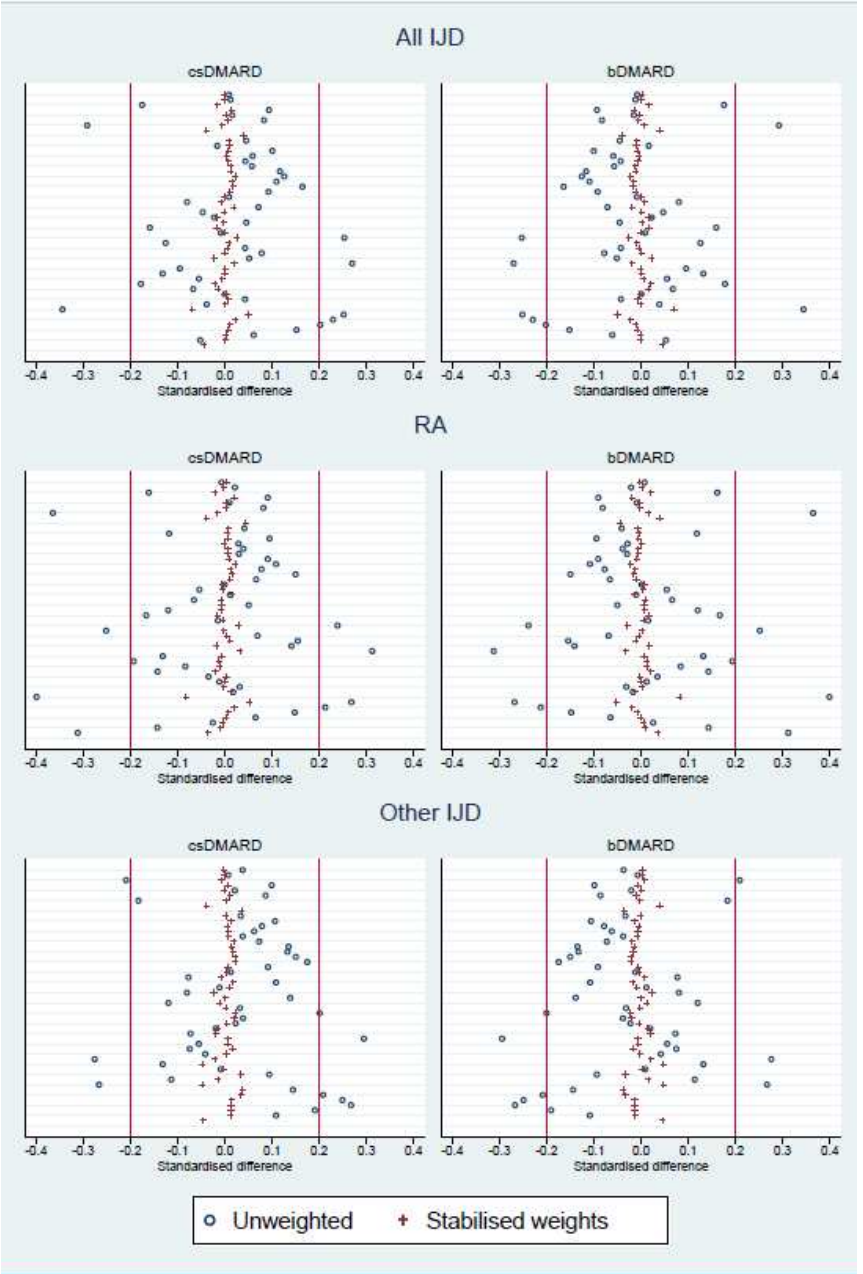
5-9 years	0.069	0.004	-0.037	-0.012	-0.086	0.002	0.008	0.024	-0.094	0.025	-0.062	-0.014
10+ years	-0.252	0.003	0.125	0.009	0.205	-0.081	0.190	0.021	0.399	0.035	0.149	-0.071
Education												
<9 years	0.239	0.025	-0.208	-0.021	-0.087	-0.049	-0.175	-0.038	-0.082	-0.014	-0.178	0.029
9-12 years	-0.015	-0.006	-0.011	0.009	0.010	0.032	0.062	0.007	0.056	-0.014	0.032	-0.022
12+ years	-0.167	-0.013	0.171	0.006	0.056	0.002	0.067	0.022	0.002	0.026	0.101	0.002
Female	-0.120	-0.024	0.053	0.005	0.155	0.067	0.141	-0.001	0.088	0.030	0.183	0.044
Hospital days (previous 10 years)												
0	0.050	0.000	0.090	0.025	-0.209	-0.049	-0.111	-0.039	-0.293	-0.107	-0.166	0.080
1-6	-0.066	-0.013	0.071	0.008	0.017	0.029	0.011	-0.010	0.005	0.007	0.032	0.020
7+	0.011	0.012	-0.160	-0.033	0.199	0.023	0.104	0.049	0.298	0.104	0.140	-0.101
Hospital days (previous year)												
0	-0.054	-0.002	0.128	0.026	-0.087	-0.052	0.081	-0.011	-0.157	-0.096	-0.088	0.055
1-3	-0.001	-0.013	-0.034	-0.002	0.057	-0.018	-0.026	0.048	0.090	0.060	0.030	-0.001
4+	0.066	0.012	-0.128	-0.031	0.060	0.077	-0.077	-0.023	0.119	0.069	0.083	-0.066
Comorbidities												
Cancer	0.150	0.013	-0.162	-0.011	-0.068	0.014	-0.140	-0.049	0.073	0.037	-0.088	-0.072
Diabetes	0.077	0.012	-0.111	-0.020	0.071	0.019	-0.055	0.044	0.060	0.032	-0.024	-0.066
Heart failure	0.108	0.020	-0.138	-0.024	0.055	0.029	-0.077	-0.007	0.053	0.023	-0.053	-0.067
IHD	0.091	0.012	-0.117	-0.013	0.071	0.034	-0.128	0.021	0.069	0.035	-0.050	-0.109
Infections	0.030	0.008	-0.104	-0.027	0.117	0.040	-0.053	0.037	0.154	0.061	0.082	-0.050
Kidney failure	0.039	-0.002	-0.064	-0.027	0.036	0.036	-0.001	0.148	0.059	0.089	-0.035	-0.096
Lung disease	0.029	-0.016	-0.145	-0.027	0.219	0.129	-0.006	-0.004	0.251	0.114	0.054	-0.008
Stroke	0.094	0.008	-0.090	-0.007	0.001	-0.008	-0.071	-0.005	0.002	0.054	-0.112	-0.089
Joint surgery	-0.118	0.009	0.013	-0.011	0.191	-0.027	0.153	-0.012	0.214	0.016	0.167	0.009
VTE	0.041	0.011	-0.063	-0.012	0.010	-0.019	-0.043	-0.010	0.037	0.007	0.037	0.000

N previous biologics												
0	0.819	0.052	-0.248	-0.020	-1.168	-0.064	-1.161	-0.085	-0.814	-0.051	-1.319	-0.072
1-2	-0.686	-0.043	0.294	0.017	0.925	0.072	0.931	0.068	0.676	0.037	0.688	0.050
3+	-0.365	-0.024	-0.040	0.009	0.610	-0.003	0.587	0.043	0.372	0.033	1.309	0.050
Region												
North	0.081	0.007	-0.077	0.006	0.068	0.016	-0.146	-0.131	-0.023	0.005	-0.062	-0.017
South	0.009	0.013	0.027	0.006	0.043	-0.084	0.138	0.087	-0.223	-0.093	-0.011	0.023
Southeast	0.091	0.031	-0.049	-0.004	-0.109	-0.066	-0.113	-0.086	-0.117	-0.017	-0.008	-0.068
Stockholm	-0.161	-0.038	0.093	-0.003	0.087	0.052	-0.011	0.050	0.309	0.060	0.074	0.134
Uppsala/ Örebro	0.021	-0.011	-0.043	0.002	-0.026	0.020	0.063	0.018	0.054	0.012	-0.007	0.024
West	-0.007	0.005	0.026	-0.007	-0.069	0.064	0.009	0.014	-0.024	0.037	-0.004	-0.124

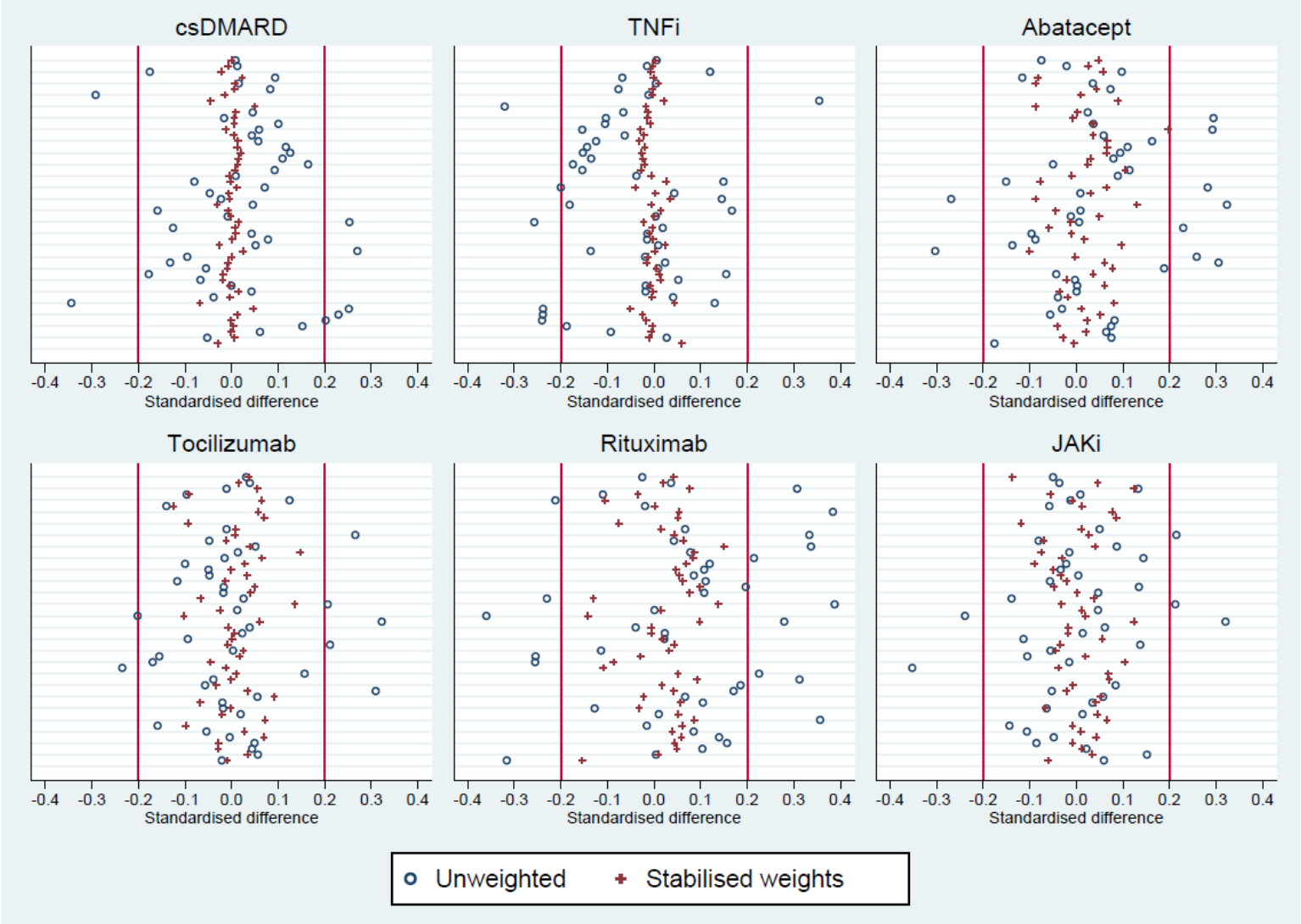
Supplementary Figure 1. Total number of deaths per day due to COVID-19 in Sweden, reported by The Public Health Agency of Sweden (Folkhälsomyndigheten, https://experience.arcgis.com/experience/09f821667ce64bf7be6f9f87457ed9aa, accessed 9th December 2020). Note that here, deaths due to COVID-19 are defined as any death that occurs within 30 days after a confirmed COVID-19 infection.



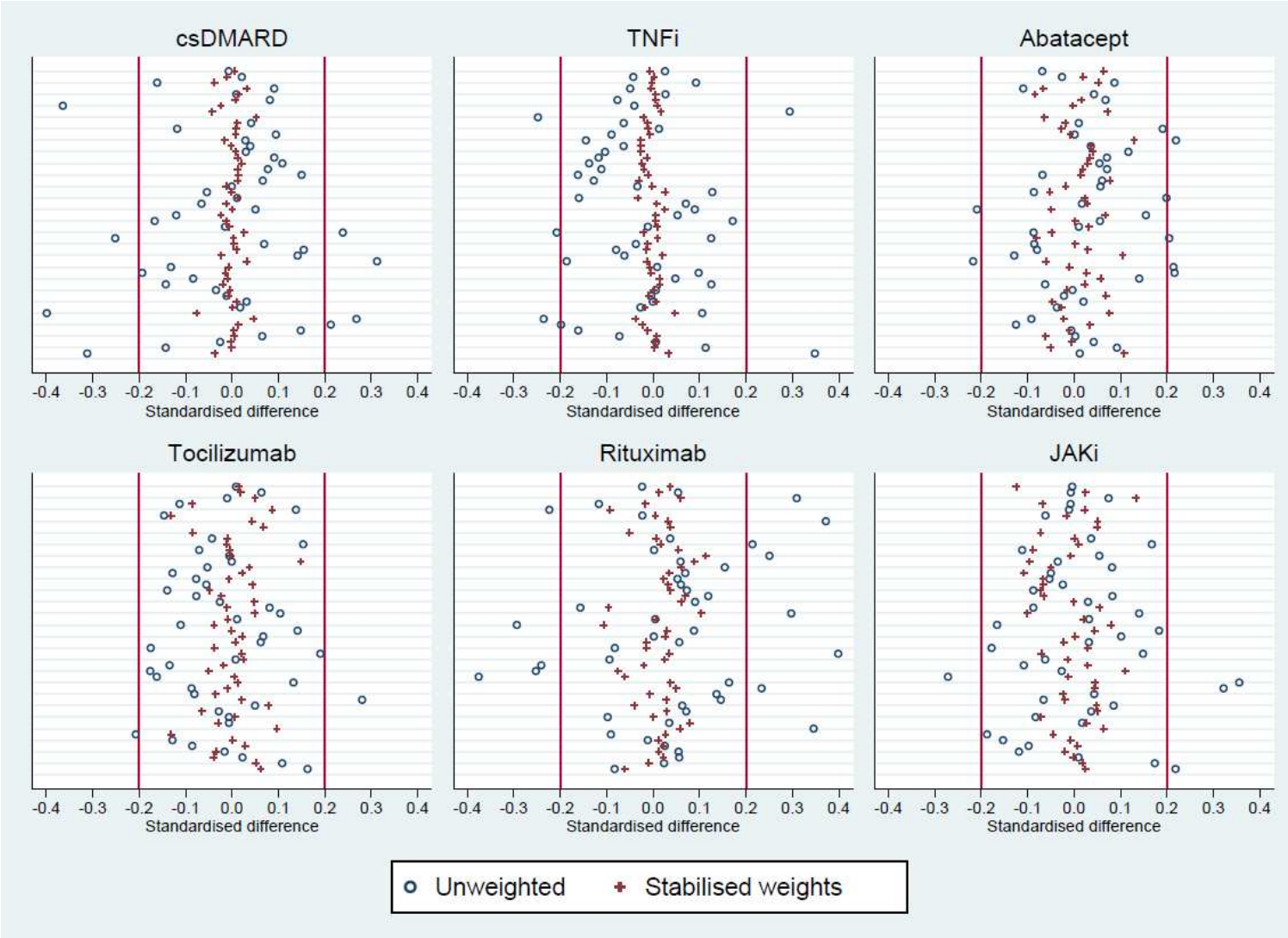
Supplementary Figure 2. Standardised mean differences from propensity score weighting for all variables included in the comparison between specific csDMARDs and bDMARDs, for all inflammatory joint diseases (IJD), RA, and other IJD.



Supplementary Figure 3. Standardised mean differences from propensity score weighting for all variables included in the comparison between DMARDs cohorts, for all patients with inflammatory joint diseases



Supplementary Figure 4. Standardised mean differences from propensity score weighting for all variables included in the comparison between DMARDs cohorts, for RA patients



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For COVID-19, general health status matters more than inflammatory arthritis

For people with inflammatory arthritis, overall COVID-19 risks are low and similar to those in the general population

INTRODUCTION

COVID-19 is the disease caused by a new type of coronavirus called severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It was declared a pandemic by the World Health Organization on 11 March 2020. COVID-19 has forced people to change their behaviours to try to limit the spread of infection.

Inflammatory joint diseases include rheumatoid arthritis, psoriatic arthritis, spondyloarthritides, and juvenile idiopathic arthritis. Each has its own particular features, but common symptoms include joint pain and stiffness, which is caused by inflammation in the joint (arthritis).

WHAT DID THE AUTHORS HOPE TO FIND?

The authors wanted to see whether people with an inflammatory joint disease were at higher risk of hospitalisation or death than people in the general population during the initial phase of the COVID-19 pandemic, and in comparison to previous years.

They also wanted to see whether people with inflammatory joint disease had an increased risk of hospitalisation, admission to intensive care, or death specifically due to COVID-19. Finally, the research looked at how treatment with biologic or targeted disease modifying anti-rheumatic drugs (often shortened to b- or tsDMARDs) affected these risks.

WHO WAS STUDIED?

The study looked at over 110,000 adults with inflammatory joint diseases living in Sweden. Almost 500,000 people from the general population in Sweden were used to compare against.

HOW WAS THE STUDY CONDUCTED?

This was a retrospective observational study. This means that the authors used existing databases of patient records. They looked for information about people with inflammatory joint diseases, and records of deaths and hospital admissions due to COVID-19 between March and September 2020.

Rates were compared between people with inflammatory joint diseases, and between those taking different treatments. These rates were compared to similar individuals in the general population.

WHAT WAS THE MAIN FINDING?

The authors found that the rate of death due to any cause was increased both in people with inflammatory joint diseases and in the general population during the first wave of the pandemic in 2020 compared to any year between 2015 and 2020.

For people with inflammatory joint disease, the risks of hospitalisation, admission to intensive care, and death due to COVID-19 were low in absolute terms. Although low, the risks were still higher than those for people in the general population. However, the authors note that these increased risks could be explained by other differences. For example, differences in general health and socioeconomic characteristics between people with inflammatory joint disease and the general population, as well as by the underlying effects of the arthritis itself. There was not much evidence that the drugs used to treat inflammatory joint diseases were associated with worse COVID-19 outcomes.

ARE THESE FINDINGS NEW?

Yes. Many studies in this area have focused on comparing risks in people with inflammatory joint disease, rather than put results into context by comparing them to similar individuals from the general population.

WHAT ARE THE LIMITATIONS OF THIS STUDY?

The data sources used meant that it was possible to look at a large study population, but also provided some limitations. When using existing health records, it is not possible to be completely sure that the information on a disease is correct. Similarly, although the databases contain information about prescriptions, it is not possible to tell whether a person actually took their medication.

The authors were not able to identify risks associated with getting SARS-CoV-2 infection. They also did not have information on people's weight or blood pressure, which are known COVID-19 risk factors. Finally, drawing conclusions was difficult for some outcomes where there were small numbers.

WHAT DO THE AUTHORS PLAN TO DO WITH THIS INFORMATION?

The next step is to extend this study to follow people through the later phases of the pandemic. This will allow the authors to see how the pandemic has affected care of inflammatory joint diseases in Sweden.

WHAT DOES THIS MEAN FOR ME?

If you have a type of inflammatory arthritis, these results suggest that you should not be worried that your disease or the medicine used to treat it will put you at increased risk of hospitalisation, admission to intensive care unit, or death due to COVID-19. However, rheumatic diseases do increase risks for many adverse health outcomes, including those related to COVID-19.

Protect yourself from COVID-19 by following the advice of the government in your country. The best protection is getting vaccinated, but you should also wash your hands regularly, avoid touching your face, and follow social distancing rules. Maintaining good ventilation may also help stop the virus spreading.

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