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Trajectory of Healthcare Resource Utilization in Giant Cell Arteritis: A Population-based Study

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ABSTRACT. ***Objective.*** To estimate the healthcare resource utilization (HRU) in patients with giant cell arteritis (GCA) compared with the general population in southern Sweden.

Methods. The study sample comprised 653 patients with GCA along with 10 age-, sex-, and residency area–matched reference subjects per patient. Data on public and private healthcare consultations and hospitalizations were extracted from the Skåne Healthcare Register. We assessed trajectories of primary and specialist healthcare visits, as well as hospital admissions and inpatient days from 3 years before through 5 years after the date of GCA diagnosis for patients and matched references. HRU was analyzed using generalized estimating equations adjusted for sex, age at the index year, calendar year of diagnosis, education, income, marital status, place of birth, and Charlson Comorbidity Index. Inverse probability weighting was used to account for dropout during study.

Results. Patients with GCA had higher rates of healthcare visits than the references from the year before GCA diagnosis and up to 4 years after diagnosis, with the largest relative (rate ratio 1.85, 95% CI 1.68–2.05) and absolute (mean difference 10.2, 95% CI 8.1–12.3 visits per person) differences in the year of diagnosis. Similar trajectories were observed for primary and specialist healthcare visits. For hospital admissions and inpatient days, the differences disappeared 1 year after diagnosis date.

Conclusion. Patients with GCA utilized healthcare services at a significantly higher rate than the reference population. The increased utilization among Swedish patients with GCA was evident 1 year before and prolonged up to 4 years after diagnosis date.

Key Indexing Terms: comorbidities, disease burden, health economics, matched population, vasculitis

Giant cell arteritis (GCA) is a primary systemic vasculitis of unknown etiology affecting large arteries, especially the aorta and its main branches.[1] GCA presents a female:male ratio of 3:1[2] and rarely occurs before age 50 years, with incidence rising rapidly after 50 years. GCA is most common in populations of Northern European ancestry. The reported incidence of biopsy-verified GCA in Sweden is 14.1–22 per 100,000 inhabitants aged ≥ 50 years.[2,3] Common clinical presentations include new-onset headache, scalp tenderness, fever, and constitutional systemic signs.[4,5,6] The most feared complication is vision impairment or irreversible blindness due to involvement of the arteries supplying the optic nerves.[7,8] The diagnosis of GCA is based on clinical characteristics and is usually confirmed by temporal artery biopsy demonstrating vasculitis. In recent years, diagnosis of GCA has also been based on imaging studies, especially positron emission tomography/computed tomography scans, revealing the presence of inflammatory changes in large blood vessels.[9] Glucocorticoids (GCs) are the cornerstone in the treatment of GCA, often requiring high to moderately high doses for a long duration to achieve and maintain remission.[10,11] Prolonged exposure to GCs and high cumulative doses are well-known risk factors for comorbidities including osteoporosis, diabetes, cardiovascular diseases, and infections,[12] and are associated with increased healthcare cost.[13]

Previous studies have demonstrated that patients with GCA suffer a higher rate of cardiovascular disease, severe infection, and venous thromboembolic disease compared to the general population.[14,15] GCA and associated comorbidities are believed to produce a substantial societal and health economic burden, but few studies of the economic consequences of GCA are available. Studies have shown that patients with GCA utilize healthcare resources to a greater extent than the general population.[16,17]

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A study by Valent, *et al* demonstrated a high burden of GCA in terms of healthcare resource utilization (HRU), and that healthcare cost of GCA was comparable to more common chronic diseases such as diabetes.[18] The majority of published reports originate from estimates by pharmaceutical industries relying on administrative registries in confirming the diagnoses or are limited to hospitalization costs.[16,19,20] However, no studies have assessed the consultation rates of patients with GCA in Sweden. In this population-based study, we aimed to estimate the rate of HRU in a large cohort of patients with biopsy-confirmed GCA compared to the general population in southern Sweden. Further, we aimed to shed light on the pattern and trajectories of HRU over a longer time period prior to and after disease onset to account for the effect of both disease factors and treatment on the rate of HRU.

METHODS

Study area and population. The study area included Skåne, the southernmost region in Sweden, with a population of 1.3 million (36% > 50 yrs). The study area and population have been described in detail.[2] Women made up 50.4% of the study population. The age distribution was 0–14 years (18.8%), 15–54 yrs (54.6%), and > 55 years (26.6%; www.scb.se). The healthcare system in Skåne comprises both public and private providers. The Region Skåne, the administrative body, manages the public health care. All residents in Sweden are covered by healthcare insurance, and the maximum cost for each individual per annum is Swedish kronor (SEK) 1150 (US $143) for health care and SEK 2300 (US $288) for drugs. After these limits, all care and pharmaceuticals are provided by the Region at no cost to the individual.

The Skåne Healthcare Register. The Skåne Healthcare Register (SHR) is a central database into which all information on healthcare contacts and diagnosis codes is transferred. The SHR receives data from primary outpatient care, private clinics, and specialized in-hospital care. Every single healthcare consultation (public or private) at any level (physician or paramedic) generates a data entry by the provider that is transferred to the SHR.[21] Data in the SHR are available from January 1998 and include records of all consultations with physicians and other healthcare personnel, as well as hospitalizations with admission and discharge dates. All physicians report diagnoses according to the assigned International Classification of Diseases, 10th revision codes. The proportion of assigned diagnosis codes in relation to consultations varies depending on level of health care and type of consultation, but it is close to 100% for inpatient care. For specialist outpatient care, this proportion increased from around 60% in 2001 to reach 100% in 2017. The proportion of consultation-assigned diagnosis codes was lowest for primary care but successively increased to reach 100% for consultations with a physician after 2004 and 66% for all consultations in 2016.[21]

Study population. Patients with incident biopsy-verified GCA from 1997 through 2016 in Skåne make up a GCA cohort that has been extensively studied.[2,14,22,23] The case identification was carried out using the registries of the Department of Pathology in Skåne by examining reports of all temporal artery biopsies from 1997.[2] As data in the SHR are only available from 1998, and the study was designed to include HRU 3 years prior through 5 years after diagnosis date of GCA, only patients diagnosed from January 1, 2001, through December 31, 2011, were included in the current study.

For each patient with GCA, 10 reference subjects from the general population in Skåne, matched for age (± 1 yrs), sex, and residency area (parish) were randomly selected from an at-risk population. All reference subjects had at least 1 clinic visit during the same calendar year as their respective cases with any diagnosis made by any physician in the Skåne region. The date of enrollment in the study was defined as the date of diagnosis of GCA. The same date was assigned to each matched reference subject. The observation period was defined relative to the index date (i.e., the first 365 days from the index date was defined as the index year). In this study, the term "reference subjects" was preferred over "controls" as this was not a case-control study in the strict epidemiologic definition, but rather exposure-matched.

Linking of the GCA cohort and reference population to data sources. The cohort of the GCA and the reference subjects were linked to the databases and registries used by personal identification numbers (Table 1) in order to identify all data relevant to the assessment of HRU.

Definition of HRU. HRU was defined as the number of consultations with healthcare facilities including primary healthcare centers, hospital services for outpatient clinics, and inpatient departments in both public and private sectors. Healthcare resources were classified as primary healthcare consultations, defined as all registered physical visits to primary health facilities in Skåne, specialist care consultations, and hospital admissions. HRU was assessed from 3 years prior through 5 years after the date of GCA diagnosis/index date. In addition to hospital admissions, we calculated total days in hospital.

Registries and databases. The registries and databases used in this study are summarized in Table 1.

Study period. Data from 1998 through 2016 were obtained from the SHR. HRU was assessed from 3 years prior to diagnosis date of GCA through 5 years following this date. Accordingly, patients diagnosed from 2001 through 2011 were included in the study.

Statistical analyses. We used generalized estimating equations (GEEs)[24] to compare trajectories of HRU in the GCA and reference cohorts over an 8-year observation period (from 3 years prior to 5 years following the index date). GEEs take into account the dependencies of observations for each individual. Since we had count data, we ran GEEs with Poisson and negative binomial distributions and log link function. Based on the Quasi-likelihood under Independence Model Criterion (QIC) selection criterion,[25] an independent covariance matrix with negative binomial distribution provided the best fit to the data for all, primary, specialist, and inpatient days. For hospital admissions, an unstructured covariance matrix with Poisson distribution was the preferred model. From these models, the differences in HRU between the 2 cohorts were reported as rate ratio (RR) with 95% CI. We used "margins" command in Stata 15 (StataCorp) to obtain the predicted annual mean number of healthcare visits per person and the annual mean differences per person between the 2 cohorts with 95% CI. To assess between- and within-cohort differences in healthcare visits, we introduced an interaction term between GCA and year of observation (spanning 8 yrs). To minimize the effect of possible confounding factors, all models were adjusted for sex, age at the index year, calendar year of diagnosis, socioeconomic status (education, income, marital status, and place of birth), and Charlson Comorbidity Index.[26] Education, income, and marital status were registered at the start of observation (i.e., 3 yrs prior to the index date) and Charlson Comorbidity Index was calculated based on 3-year data before index date (i.e., from the start of observation up to the index date).

To account for dropout during the observation period, we used inverse probability weighting. We used logistic regression to predict probability of dropout for each year after the index date (by study design, people could not drop out of the study before the index date) based on participants' GCA status, sex, age at the index year, socioeconomic status, comorbidity index, and calendar year of diagnosis. Then, these probabilities were multiplied to generate 1 probability per person and inverse of this probability (1 – probability) was used as weight for people with incomplete (complete) data in GEE models. Further, we included the length of follow-up time in each year as offsets in our models.

Ethical approval. The study is based on registry data that were linked through the use of a personal identifier. Ethics approval was provided by the ethical review board in Lund (Dnr. 2010/517, 2013/720, and 2017/298).

Table 1. Registries and databases utilized in this study.

Registry	Description	Role
Skåne Healthcare Register (SHR)	A central database in which all levels of health care are reported. The diagnoses in the SHR are registered using the ICD-10.	The SHR was used to identify all diagnosed comorbidities of interest.
Swedish Population Register	A nationwide register containing current information on all residents of Sweden including residential address and dates of immigration to and emigration from Sweden.	To obtain residency information of living subjects.
LISA register	A central database beginning in 1990 integrating existing data from the labor market, educational, and social sectors, and is updated annually.	To obtain data on socioeconomic status.

ICD-10: The International Classification of Diseases, 10th revision; LISA: Longitudinal Integrated Database for Health Insurance and Labour Market Studies.

RESULTS

Patients and reference subjects. Patients with biopsy-verified GCA from the Skåne region diagnosed from January 2001 through December 2011 were included in the study. This comprised 653 patients with GCA (479 females, 73.4%) with 58% diagnosed at age ≥ 75 years (mean 75.3 [SD 8.3] yrs) and 6571 reference subjects (4825 females, 73.4%). Table 2 summarizes the primary demographic characteristics of patients and reference subjects.

HRU. The mean number of healthcare visits in the reference cohort rose slightly from 10.1 visits per person in Year –3 to 11.2 in the index year, and was stable thereafter (Figure 1). In the GCA group, this figure increased from 9.7 in Year –3 to 21.5 in the index year and declined to 12.8 in Year 4. In both groups, primary care visits constituted more than half of all healthcare visits in all study years (except for the GCA group in the index year). Hospital admissions for infectious diseases (5.6% vs 3.4%), mental and neurological diseases (8.2% vs 6.1%), and musculoskeletal disorders (12.1% vs 7.9%) constituted a larger proportion of total hospital admissions in the GCA group compared to

Table 2. Characteristics of patients with giant cell arteritis (GCA) and reference subjects.

	GCA, n = 653	Reference Subjects, n = 6571
Female sex, n (%)	479 (73.4)	4825 (73.4)
Age at diagnosis, yrs, mean (SD)	75.3 (8.3)	75.3 (8.3)
Age groups, yrs, n (%)		
48–64	74 (11.3)	728 (11.1)
65–74	198 (30.3)	2012 (30.6)
75–84	302 (46.3)	3037 (46.2)
85–95	79 (12.1)	794 (12.1)
Charlson Comorbidity Index, %		
0	41.8	61.2
1	35.2	18.7
> 1	23.0	20.1
Education, %		
0–9 yrs	47.3	49.5
10–12 yrs	*35.5*	*33.1*
≥ 13 yrs	14.9	15.2
Missing	2.3	2.2
Born abroad, %	8.6	11.4
Marital status, %		
Never married	8.0	6.2
Previously married	39.4	39.2
Married	52.7	54.6
Lost during follow-up, n (%)		
Died	141 (21.6)	1354 (20.6)
Moved out from Skåne	12 (1.8)	87 (1.3)

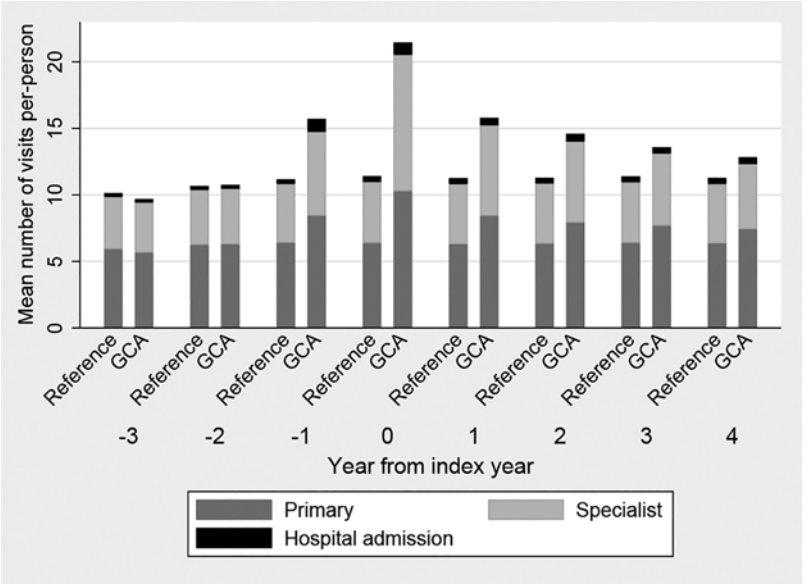

Figure 1. The mean healthcare visits per person in GCA and reference population during the study time. GCA: giant cell arteritis.

the reference cohort (Supplementary Figure 1, available with the online version of this manuscript).

The results of GEE showed that while the 2 cohorts had comparable healthcare visits in the first 2 years of observation (RR 0.90, 95% CI 0.78–1.02 and 1.01, 95% CI 0.87–1.14 for Years –3 and –2, respectively), the patients with GCA started to have more healthcare visits from the year before (RR 1.39, 95% CI 1.19–1.60) until 4 years after the index date (Figure 2). Similar patterns were observed for primary and specialist care visits, whereas for hospital admission and inpatient days the differences were only evident for 1 year before and 1 year after the index date. In particular, the RR for hospital admission reached its highest level during the year before the index year (RR 2.24, 95% CI 1.92–2.56; Figure 2).

After adjustment for all covariates, the patients with GCA had 9.8 (95% CI 8.6–11.1) healthcare visits per person at Year –3 (Figure 3) compared with 10.9 (95% CI 10.4–11.5) healthcare visits per person in the reference population(mean difference of 1.1 [95% CI –0.3 to 2.5] per person; Figure 4). While the corresponding number of visits in the reference population

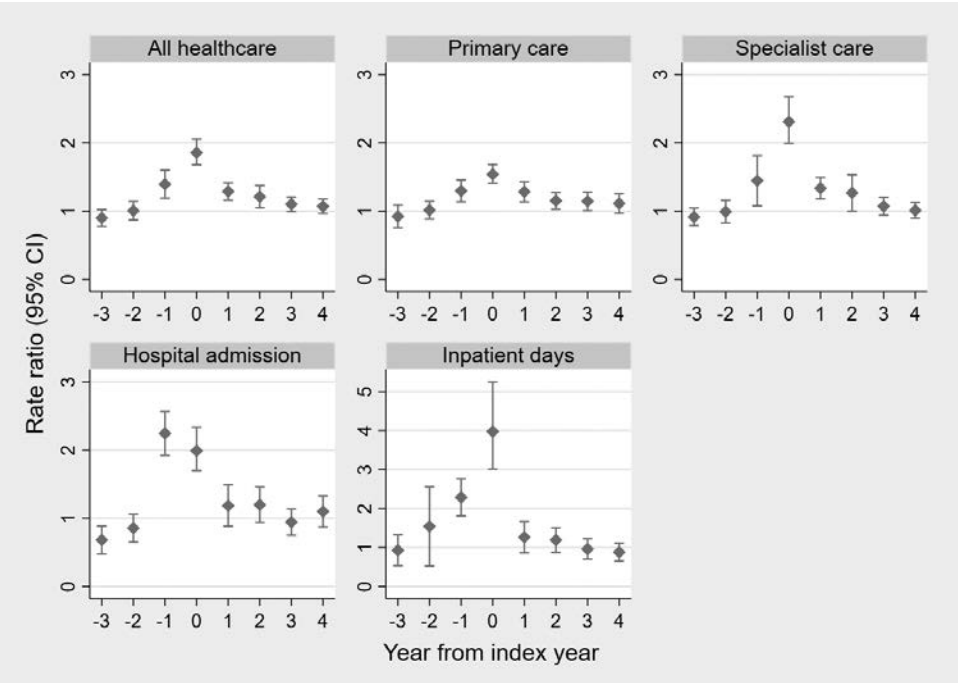

Figure 2. Rate ratio (95% CI) of healthcare visits over 8 years of observation in GCA compared with the reference subjects estimated from generalized estimating equations. GCA: giant cell arteritis.

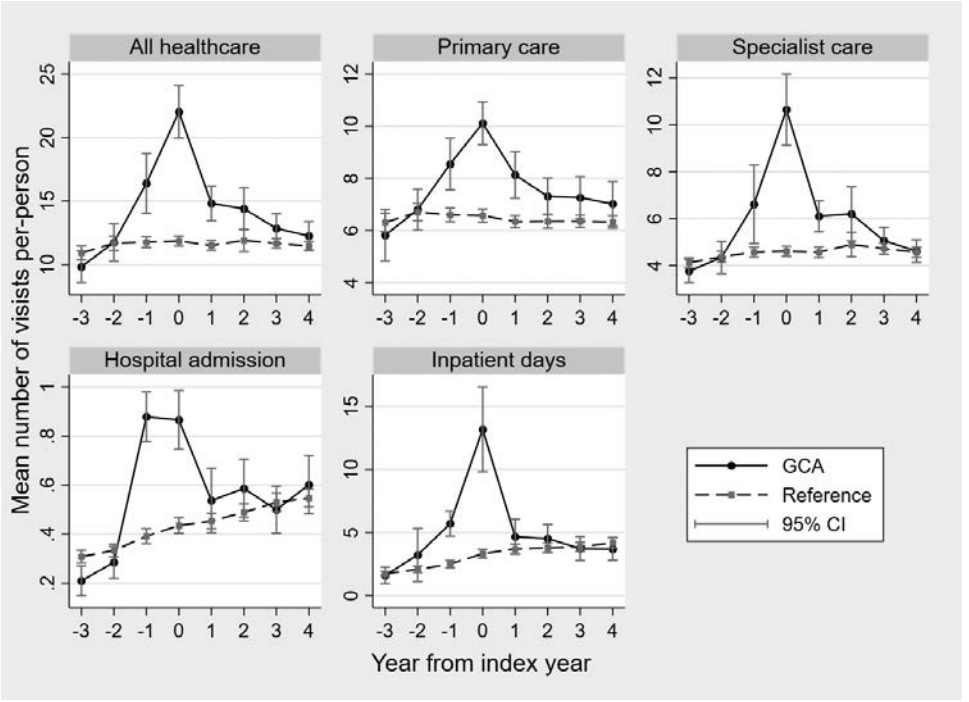

Figure 3. Mean number of healthcare visits per person in GCA compared with the reference population over an 8-year observation period estimated from the generalized estimating equations. GCA: giant cell arteritis.

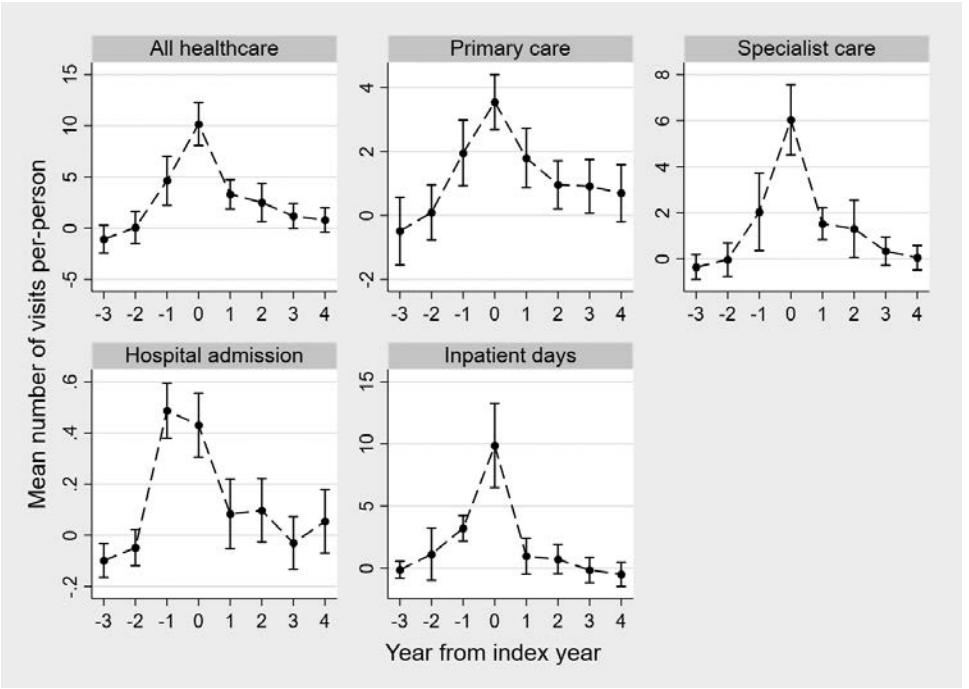

Figure 4. Mean differences in healthcare visits per person in GCA compared with the reference population over an 8-year observation period estimated from generalized estimating equations. GCA: giant cell arteritis.

slightly increased at the index year (11.9 [95% CI 11.0–12.3] visits per person), this number rose by more than double in the GCA cohort (22.0 [95% CI 20.0–24.1] visits per person). The mean differences (95% CI) per person for different types of healthcare visits at the index year were as follows: 3.5 (2.7–4.4) for primary care, 6.0 (4.5–7.6) for specialist care, 0.4 (0.3–0.6) for hospital admission, and 9.9 (6.5–13.3) for inpatient days. The mean differences in healthcare use generally rose up to the index year and declined thereafter. It also should be noted that while the mean difference in hospital admission was slightly greater in Year –1 than in the index year, the greatest difference in inpatient days was observed in the index year.

DISCUSSION

The results of this study demonstrated a higher rate of HRU for patients with GCA relative to the general population at all levels of the healthcare system. Patients with GCA showed higher mean numbers of ambulatory visits, specialist visits, hospitalizations, and inpatient hospital stays compared to reference subjects. The differences were evident in the year before GCA diagnosis and up to 4 years post diagnosis. Previous studies of HRU in patients with vasculitis are scarce.

These findings were consistent after adjustment for a number of covariates that may have an important effect on the extent of HRU. The healthcare use among patients with GCA was higher compared to the reference population after adjustment for sex, age, Charlson Comorbidity Index, and socioeconomic factors. Adjustment was also made for dropout after diagnosis/index date.

In addition to the higher rate of outpatient healthcare use, patients with GCA also showed greater duration of hospitalization compared to the reference population. The RR of all-cause hospital admission was high in GCA compared to the reference population and reached its highest level the year before diagnosis at 2.24 (95% CI 1.92–2.56), a higher estimate than that of a large study in the United Kingdom that demonstrated an RR of 1.7 (95% CI 1.6–1.8).[27] The rate of hospitalization reported has varied among countries and is difficult to compare directly for reasons including differences in treatment and access to healthcare services. Mounié, *et al* have previously demonstrated an additional increased cost of GCA with polymyalgia rheumatica (PMR) compared with GCA without PMR, mainly due to increased cost of inpatient stays, drugs, and increased paramedic care.[28] Similarly, the rate of inpatient hospital admissions for the investigation of GCA and PMR in the UK increased during a period from 2002 to 2013.[29] However, a previous study using the Swedish Inpatient Registry demonstrated a substantial decrease from 1998 to 2016 in the absolute and relative burden of hospitalization due to systemic connective tissue disease including vasculitis, possibly reflecting improvements in disease management in Sweden.[30] HRU after diagnosis of GCA may have been influenced by the higher rate of comorbidities in patients with GCA. It has been previously shown that patients with GCA have a significantly higher rate of ischemic heart diseases, stroke, and traditional risk factors for cardiovascular events; a 2-fold higher occurrence of venous thromboembolic disease; and a nearly 2-fold increase in rate of severe infections and septicemia.[14,23,31,32] This increase in comorbidity rates may partially explain the higher rate of HRU seen in this study, at least after GCA onset. However, disease-specific factors may have an important effect as well, as we also demonstrated similar findings of increased HRU during the year before GCA onset, even after adjustment for comorbidities. We have recently shown that patients with GCA had a higher rate of infections prior to disease onset compared to the general population.[33] Possibly, another contributing factor could be that the treating physician may have an increased tendency to admit patients with GCA to hospital for mild illness or to prolong hospital stays. However, this bias is unlikely to have occurred prior to the diagnosis of GCA.

Few studies have assessed the economic consequences of vasculitides. The majority have originated from estimates obtained with the aid of pharmaceutical companies, relied largely on patient administrative registries in the United States, were limited to quantification of hospitalization costs, and, perhaps most importantly with respect to our study, were not representative of Swedish hospital practices and costs.[16,19,20] Not only are these diseases debilitating for the individual, but they also give rise to a substantial health-related economic and societal burden. Many of these comorbidities are the direct result of GCA treatment, including long-term exposure to GCs. It is therefore important to consider using lower doses of GCs and/or shorter duration of treatment. It is also essential to increase healthcare awareness in patients at risk of developing comorbidities and to expand the use of preventative measures in patients with GCA. Studies of procedures aiming to decrease the risk of comorbidities in vasculitis should also be encouraged by healthcare providers and granting agencies, as these would affect not only the well-being of individual patients, but also the resources of the community.

Strengths of this study include the use of a large population-based cohort of patients with GCA with no selection bias. The study utilized validated sources of diagnosis and healthcare contacts and covered a period of 10 years. Limitations include that the study totally relied on data from the Skåne Healthcare Register, and no clinical data had been collected from case records. However, in a previous study from the same cohort, we found that 10% of the patients had visual complications and almost 98% of cases fulfilled the American College of Rheumatology 1990 classification criteria for GCA.[23,34] Further, comorbidity data on the first 840 patients in the cohort have been previously published.[14] The cohort only includes patients diagnosed with positive temporal artery biopsy and may not be fully representative for patients with other disease phenotypes within GCA, such as those with isolated large-vessel disease. Finally, the comparator in this study consisted of reference subjects from the general population. Further studies comparing HRU in patients with GCA to that in patients with other chronic diseases would be of interest.

Based on a large population-based study, we demonstrated, for the first time in Sweden, to our knowledge, that patients with biopsy-verified GCA accessed healthcare resources at a significantly higher rate compared to a general population adjusted for factors including sex, age, year of diagnosis, socioeconomic factors, and dropout after index date. The increase in HRU was evident at all levels of healthcare contact 1 year prior to the diagnosis of GCA and up to 4 years following diagnosis. These results should be taken into consideration in planning for care of patients with GCA, especially as novel therapeutic interventions beyond the traditional GCs become available.

ONLINE SUPPLEMENT

Supplementary material accompanies the online version of this article.

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