

Degenerative Shoulder Diseases: Shoulder Injuries, Epidemiology, ICD10, Coding

Degenerative Schultererkrankungen und Schulterverletzungen: Epidemiologie, ICD10-Codierverhalten und Versorgungsrealität – Datenanalyse von 4,9 Mio. Versicherten der AOK Baden-Württemberg



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ABSTRACT

Despite the increasing number of cases in recent years, there are currently no data available on the disease and care situation for degenerative shoulder diseases and shoulder injuries, as well as on the ICD-10 coding behaviour of the treating physicians. This paper presents, for the first time, a descriptive analysis based on billing data from 2022 of coded shoulder diseases affecting 4.9 million insured individuals of a statutory health insurance in Baden-Württemberg. The study distinguishes between accident-related shoulder injuries and diseases caused by degenerative changes in the shoulder. In ICD-10 coding, a distinction is made between specific codes (using key numbers of the underlying disease) and non-specific codes that only encode the symptom. According to billing data, women were slightly more affected by shoulder diseases than men (7.3% vs. 6.9%), with women being significantly older on average at the time of diagnosis. For fractures, the gender difference averaged 20 years. The analysis of coding behaviour revealed that general practitioners coded non-specific shoulder diseases, such as joint pain or impingement syndrome, more frequently than other specialist groups. The analysis of the claiming of benefits showed that only one-third of the evaluated patients received imaging, and only 40% received a prescription for physiotherapy due to a shoulder diagnosis. The investigation of comorbidities found that patients with degenerative shoulder diseases were more frequently affected

by metabolic diseases and hypertension than those without shoulder diseases. These results regarding the frequency of coded shoulder diseases in various health sectors demonstrate their importance in the Federal Republic of Germany for both men and women. In summary, the evaluations—despite methodological limitations—suggest that there may be potential for more specific coding in the diagnosis and prescription of therapeutic measures. A more precise understanding of the actual cause of claiming health services can be helpful for the provider to initiate specific diagnostic and therapeutic measures and identify a potentially increased need for care within the health system in the Federal Republic of Germany.

ZUSAMMENFASSUNG

Trotz steigender Erkrankungszahlen in den letzten Jahren liegen bisher keine Daten zum Krankheits- und Versorgungsgeschehen für degenerative Schultererkrankungen und Schulterverletzungen sowie zum ICD10-Codierverhalten der versorgenden Ärztinnen und Ärzte vor. Die vorliegende Arbeit stellt erstmals eine deskriptive, auf Abrechnungsdaten aus dem Jahr 2022 basierende Auswertung von codierten Schultererkrankungen von 4,9 Mio. Versicherten einer gesetzlichen Krankenversicherung in Baden-Württemberg vor. In der Untersuchung wird unterschieden zwischen unfallbedingten Verletzungen an der Schulter und Krankheiten, hervorgerufen durch degenerative Veränderungen des Schulterapparats. Bei der ICD10-Codierung wird zwischen der Angabe spezifischer (Verwendung von Schlüsselnummern der zugrunde liegenden Erkrankung), und unspezifischer Codes, die lediglich das Symptom verschlüsseln, differenziert. Laut Abrechnungsdaten waren

Frauen etwas häufiger von Schultererkrankungen betroffen als Männer (7,3% vs. 6,9%), wobei Frauen zum Zeitpunkt der Diagnosestellung im Mittel deutlich älter waren. Bei Frakturen lag der Geschlechterunterschied durchschnittlich bei 20 Jahren. Die Auswertung zum Codierverhalten machte deutlich, dass Hausärztinnen und Hausärzte im Vergleich zu anderen Facharztgruppen häufiger unspezifische Schultererkrankungen wie Gelenkschmerz oder Impingement-Syndrom codierten. Die Analyse der Leistungsanspruchnahme zeigte, dass nur ein Drittel der evaluierten Patientinnen und Patienten eine Bildgebung und nur 40% eine Verordnung für Physiotherapie aufgrund einer Schulterdiagnose erhielten. Die Untersuchung der Komorbiditäten ergab, dass Patientinnen und Patienten mit degenerativen Schultererkrankungen häufiger von stoffwechselbedingten Krankheiten und Hypertonie betroffen waren als solche ohne Schultererkrankungen. Diese Ergebnisse zur Häufigkeit codierter Schultererkrankungen in den verschiedenen Gesundheitssektoren zeigt die Relevanz in der Bundesrepublik Deutschland für Männer und Frauen gleichermaßen. Zusammenfassend lassen die Auswertungen – trotz methodischer Einschränkungen – vermuten, dass bei der Diagnosestellung und der Verordnung von therapeutischen Maßnahmen Potenzial für eine spezifischere Codierung gegeben sein könnte. Das präzisere Wissen um die tatsächliche Ursache der Inanspruchnahme von Gesundheitsleistungen kann einerseits für den Behandler hilfreich sein, um spezifische Diagnostik- und Therapiemaßnahmen einzuleiten und andererseits einen u.U. erhöhten Versorgungsbedarf innerhalb des Gesundheitssystems in der Bundesrepublik Deutschland zu identifizieren.

Introduction

The global incidence and prevalence of shoulder diseases has been increasing for years [1, 2]. But despite this increasing burden of disease, awareness of this issue appears to be limited. In contrast to knee, hip and wrist arthrosis, acromioclavicular joint arthrosis or arthrosis of the shoulder joint is not a diagnosis for which the global burden of disease is recorded in the Global Burden of Disease (GBD) study [3]. For 33 years, the GBD study has carried out regular investigations into the global impact of diseases and risk factors which have provided a clear picture over time of the health status of people living in different countries. In their study, however, arthrosis of the shoulder is simply grouped together with other degenerative joint changes under the collective term “other arthroses”, which does not clearly show their contribution to public health burdens.

The current study situation is best described as heterogeneous. Consequently, the collected figures diverge to some extent, which may be due to very specifically defined study populations, age groups, and diagnostic criteria. Moreover, a high prevalence of prior asymptomatic changes are assumed, especially with regards to rupture of the rotator cuff [4, 5, 6].

Despite the increasing global importance of shoulder diseases, there are no reliable figures on the incidence and prevalence, on imaging and the coding behaviour of different groups of medical specialists, or about the prescription of medications in the Federal Republic of Germany [7]. In a recently published editorial in the medical journal *Deutsches Ärzteblatt*, Berger et al. [8] pointed out that while data from health insurance companies do not provide precise comprehensive documentation of care, the data does permit a simple and cost-efficient, cross-sectoral and longitudinal investigation to be made into the care provided to large numbers of people [9]. Several studies about the coding quality of diagnoses made by panel doctors for different pathologies have been published [10], but to the best of our knowledge, there has been no comparable study on shoulder diseases and injuries. Our study now provides these figures for 9 shoulder diagnoses (► **Table 1**), according to age and gender of the affected persons. The study differentiates between accident-related injuries of the shoulder and shoulder diseases caused by degenerative changes of the shoulder mechanism. The data of 4.9 million individuals insured by the statutory health insurance fund AOK Baden-Württemberg (AOK BW) were evaluated.

► **Table 1** Assignment of ICD-10 codes to a total of 9 diagnosis groups.

Diagnosis groups	ICD-10 codes
Degenerative diseases	
Arthrosis of shoulder	M19.x1
Joint diseases of shoulder	M24.x1 (other types of specified joint damage), M25.x1 (other joint diseases, not classified elsewhere)
Diseases of synovium and tendons of shoulder	M67.x1
Rotator cuff lesions	M75.1
Impingement syndrome of shoulder	M75.4
Other shoulder lesions	M75.0 (adhesive capsulitis of shoulder), M75.2 (bicipital tendinitis), M75.3 (calcific tendinitis of shoulder), M75.5 (bursitis of shoulder), M75.6 (labrum lesion with degenerative change of shoulder joint), M75.8 (other shoulder lesions), M75.9 (shoulder lesion, unspecified)
Traumatic disease	
Fracture in the area of shoulder and upper arm	S42.0- (fracture of clavicle), S42.1- (fracture of scapula), S42.2- (fracture of upper end of humerus), S42.3 (fracture of shaft of humerus), S42.7 (multiple fractures of clavicle, scapula, and humerus), S42.8 (fracture of other parts of shoulder and upper arm), S42.9 (fracture of shoulder girdle, part unspecified)
Dislocation, sprain and strain of joints and ligaments of shoulder girdle	S43.-
Injury of muscle(s) and tendon(s) of the rotator cuff of shoulder	S46.0

The aim of this study was to make statements about the care provided to treat the most common shoulder diagnoses and comorbidities. This means that, for the first time, reliable data are presented about the reality of care for a large patient population in Germany. This will provide a verifiable database for planning needs-based prevention and care in the coming years.

Material and Methods

Data

The billing data of persons in whom a shoulder disease was coded in 2022 and who were insured by the statutory health insurance fund AOK BW were used (► **Table 1**). To obtain an understanding

of the coding behaviour of the treating physicians, unspecific codes were also chosen in addition to specific ICD-10 codes for diseases. This permits a differentiation to be made between the codes used for underlying diseases (specific) and unspecific codes which only code for the symptoms. To be able to evaluate the required diagnosis-free periods in the preceding quarters and the utilisation of services on the part of an insured individual during a maximum period of 6 months after receiving the diagnosis, data from the years 2020/2021 and from the 1st quarter of 2023 were additionally consulted. The evaluations were carried out for the period from December 2023 to February 2024. Data were analysed using SQL scripts (Toad for SAP Solutions 4.1.0.142). The coded diagnoses and data on the utilisation of services from the outpatient and inpatient care sectors and the prescribed therapeutic and medicinal products sector of a statutory health insurance were used for the analysis. Only insured persons with incidental diagnoses were included in the evaluation of the utilisation of care services. As the costs of conventional diagnostic X-ray and sonography procedures performed in hospital and in the context of selective contracts (§§ 73 c and 140 a SGB V) are not billed separately, the data for these 2 areas of care were not included in the analysis.

A case requiring treatment may be assigned to several diagnosis groups if several diagnoses were coded. Age standardisation based on the 2013 European population was done to permit comparisons between groups [11].

To determine whether shoulder diseases are associated with specific comorbidities, chi-square tests were done using RStudio Pro (version 4.2.3) for age-standardised cohorts disaggregated according to gender, and the effect size was determined using Cramer's V. The effect size measurement Cramer's V, i.e., the quantifiable extent of the effect and its practical relevance, can have a value between 0 and 1. The higher the value, the more relevant the association between the two tested variables. The `chisq.test` function of the R Stats Package [12] and the `cramersV` function of the R Isr Package [13] were used for calculations.

Data protection

Analysis was done based exclusively on routine billing data compiled internally by AOK BW which was case-related and was not related to individual insured persons. All analyses included here are the result of automated routine evaluations and are presented in anonymised form as purely numerical values or percentages. This completely excludes observations on individual insured persons. All analyses were done in compliance with data protection regulations and in consultation with the data protection officer of AOK BW.

Analysis criteria: prevalence and incidence rate

To obtain prevalence and incidence rates for 2022, the diagnoses of shoulder diseases were assigned to one of the 9 diagnosis groups. For the outpatient sector, only assured diagnoses were included in the analysis; for the inpatient sector, only the principal and secondary diagnoses were included. The diagnoses were assigned to the quarters 1/2022 to 4/2022, as the precise date when the diagnosis was coded could not be determined.

A total of 4 887 491 million people were insured by AOK BW for at least one day in the year 2022. Of these 4 887 491 million people, 343 770 insured persons (7.03 %) were recorded as having one of the shoulder diseases listed in ► **Table 1**.

The incidence rates were calculated for trauma-related shoulder injury to obtain more precise records compared to prevalence, for example, for cases which were coded multiple times in the computer-based information system of the surgery or hospital. Only insured persons who had a coded diagnosis for a shoulder injury in 2022 and had additionally been insured by AOK BW over the 8 previous quarters prior to 2022 during which period they had not had a diagnosis from the respective diagnosis group were included. This lead time without a diagnosis made it possible to select the at-risk population while excluding the possibility that the current diagnosis was related to an earlier injury in the patient's medical history. A total of 36 398 insured persons met these criteria.

Analysis criteria: comorbidities

Insured persons with prevalent or incidental shoulder disease or injury diagnosed in 2022 were checked to see whether they had also been coded in the same year for at least one assured outpatient diagnosis or an inpatient principal or secondary diagnosis of diabetes mellitus (ICD-10 codes E10–E14), hypertension (ICD-10 codes I10–I15), thyroid gland disorder (ICD-10 codes E00–E07), or lipoprotein metabolism disorder (ICD-10 codes E78.-). All insured persons who were not diagnosed with a shoulder disease or injury during the study analysis period served as the comparison group (age-matched controls).

Insured persons who were diagnosed with degenerative shoulder disease were grouped together (comorbidity group 1) as were insured persons with trauma-related disease without fractures (comorbidity group 2). Insured persons with fractures (comorbidity group 3) were additionally investigated for the comorbidity osteoporosis (ICD-10 codes M81–M82). Testing for significance and determination of the effect size was done separately for men and women.

Analysis criterion: coding behaviour

Diagnostic data from the outpatient and inpatient sector was used to evaluate the coding behaviours of the relevant medical specialist groups treating shoulder diseases and of the hospital sector. Physicians were classified into the following groups based on the medical specialist group key (as indicated by the last two numbers of the 9-digit lifelong doctor identifier number): general practitioner/internal specialist (01, 02, 03, 23), orthopaedist (10, 12), surgeon (06, 11), rheumatologist (31), physical medicine specialist (57), radiologist (62). All other medical specialist group keys were summarised as "other MS groups." This group also includes outpatient emergency treatments in hospital. Assignment to the inpatient hospital sector was differentiated according to the type of diagnosis (principal or secondary inpatient diagnosis). The coding frequency for all treatment cases according to diagnosis and medical specialist group was evaluated for the 9 diagnosis groups.

► **Table 2** Percentage of persons insured by AOK Baden-Württemberg compared to the total population of Baden-Württemberg insured in a statutory health insurance scheme. Arranged according to age and gender for the year 2022. Own calculation by AOK BW based on the number of insured persons provided by the National Association of Statutory Health Insurance Funds in Germany.

Age group (years)	Percentage of women AOK BW	Percentage of men AOK BW
0	51.6%	48.5%
1–4	47.8%	48.0%
5–9	47.6%	47.6%
10–14	47.6%	47.7%
15–19	47.5%	47.2%
20–24	45.4%	45.3%
25–29	45.4%	45.0%
30–34	45.7%	45.6%
35–39	44.5%	45.0%
40–44	43.7%	44.4%
45–49	44.7%	45.6%
50–54	43.3%	44.9%
55–59	41.6%	43.3%
60–64	42.6%	43.8%
65–69	43.5%	44.3%
70–74	43.0%	43.9%
75–79	41.3%	41.9%
80–84	44.4%	42.2%
≥ 85	49.4%	44.1%
Alle	44.7%	45.1%

Insured population

In 2022, 44.9% (men 45.1%; women 44.7%) of persons living in the federal state of Baden-Württemberg who were insured in a statutory health insurance system were insured by AOK BW. A detailed list is given in ► **Table 2**, differentiated according to age and gender. Overall, the percentage of persons insured by AOK BW amounts to 6.2% of all women and 6.3% of all men in a statutory health insurance scheme in Germany. From intermediate age onwards, the percentage of men insured by AOK BW is several percentage points higher than for women. Above the age of 80, the percentage of women is slightly higher, reaching almost 50% above the age of 85.

Results

In 2022, 181 913 out of 2.5 million women (7.3%) and 161 856 out of 2.39 million men (6.9%) insured with AOK BW received outpatient or inpatient treatment for shoulder disease or shoulder injury. The distribution of affected persons in the 9 diagnosis groups

► **Table 3** Prevalence and incidence rates of common shoulder diseases and injuries for men and women in 2022. An insured person may be included in several diagnosis groups, i.e., a case with disease/injury may be included in several diagnosis groups.

Diagnosis group	Number of insured persons affected		Mean age (years)		Age-standardised prevalence rate/100 000 IY		Number of insured persons affected		Mean age (years)		Age-standardised incidence rate/100 000 IY	
	M	W	M	W	M	W	M	W	M	W	M	W
Arthrosis of shoulder	42 375	49 759	67	73	1 984	1 799	NP	NP	NP	NP	NP	NP
Joint diseases of shoulder	39 546	37 315	54	59	1 760	1 499	NP	NP	NP	NP	NP	NP
Diseases of synovium and tendons of shoulder	529	564	57	60	24	23	NP	NP	NP	NP	NP	NP
Rotator cuff lesions	46 900	53 731	62	65	2 157	2 100	NP	NP	NP	NP	NP	NP
Impingement syndrome of shoulder	53 077	60 020	61	62	2 418	2 408	NP	NP	NP	NP	NP	NP
Other shoulder lesions	53 440	62 666	60	62	2 422	2 507	NP	NP	NP	NP	NP	NP
Fracture in the area of shoulder and upper arm	8 583	12 582	54	74	390	448	4 921	6 433	53	74	222	232
Dislocation, sprain and strain of joints and ligaments of shoulder girdle	9 680	5 308	39	61	422	210	4 937	2 784	39	59	285	146
Injury of muscle(s) and tendon(s) of the rotator cuff of shoulder	2 059	1 720	63	70	95	66	992	718	61	67	54	37

M: men; W: women; IY: number of years insured; NP: not performed

is shown in ► **Table 3**. Also shown are the age-standardised prevalence and incidence rates and the mean ages for the respective diagnosis groups. The most commonly coded diagnosis for both cohorts was for the group “other shoulder lesions,” followed by impingement syndrome, rotator cuff lesions, and shoulder arthrosis. Out of 100 000 women, 2.1 % visited a health professional in the context of a rotator cuff lesion and 2.5 % for other shoulder lesions. Out of 100 000 men, the age-standardised percentage was 2.2 % and 2.4 % respectively (s. ► **Table 3**). Of the insured persons with degenerative shoulder disease in 2022, a total of 28.7 % were diagnosed with arthrosis of shoulder, with a higher percentage found in women compared to men (women 15.5 % vs. men 13.2 %). The age-standardised rate was 1.8 % for women and 2 % for men per 100 000 insured persons. In 2022, a first treatment visit in the context of a fracture was coded for around 4900 men. The figure was significantly higher for women with around 6400 cases. A review of the age-standardised rates found no differences between men and women, with approximately 0.2 % of persons newly diagnosed with disease. However, men were affected more often by dislocations and strains than women (0.5 % vs. 0.3 % per 100 000 insured persons).

Prevalence

► **Fig. 1** shows the prevalence of degenerative shoulder disease, i.e., diseases caused by changes of the musculoskeletal system without prior trauma, and the prevalence rates of traumatic dis-

ease or after-effects of injury to the shoulder. Degenerative diseases of the shoulder joint significantly outweigh traumatic injuries, peaking in the 5th and 6th decades for impingement syndrome, rotator cuff lesions and other shoulder diseases and a sharp increase in arthrosis of shoulder from the age of 40 which increases even more sharply in women than men.

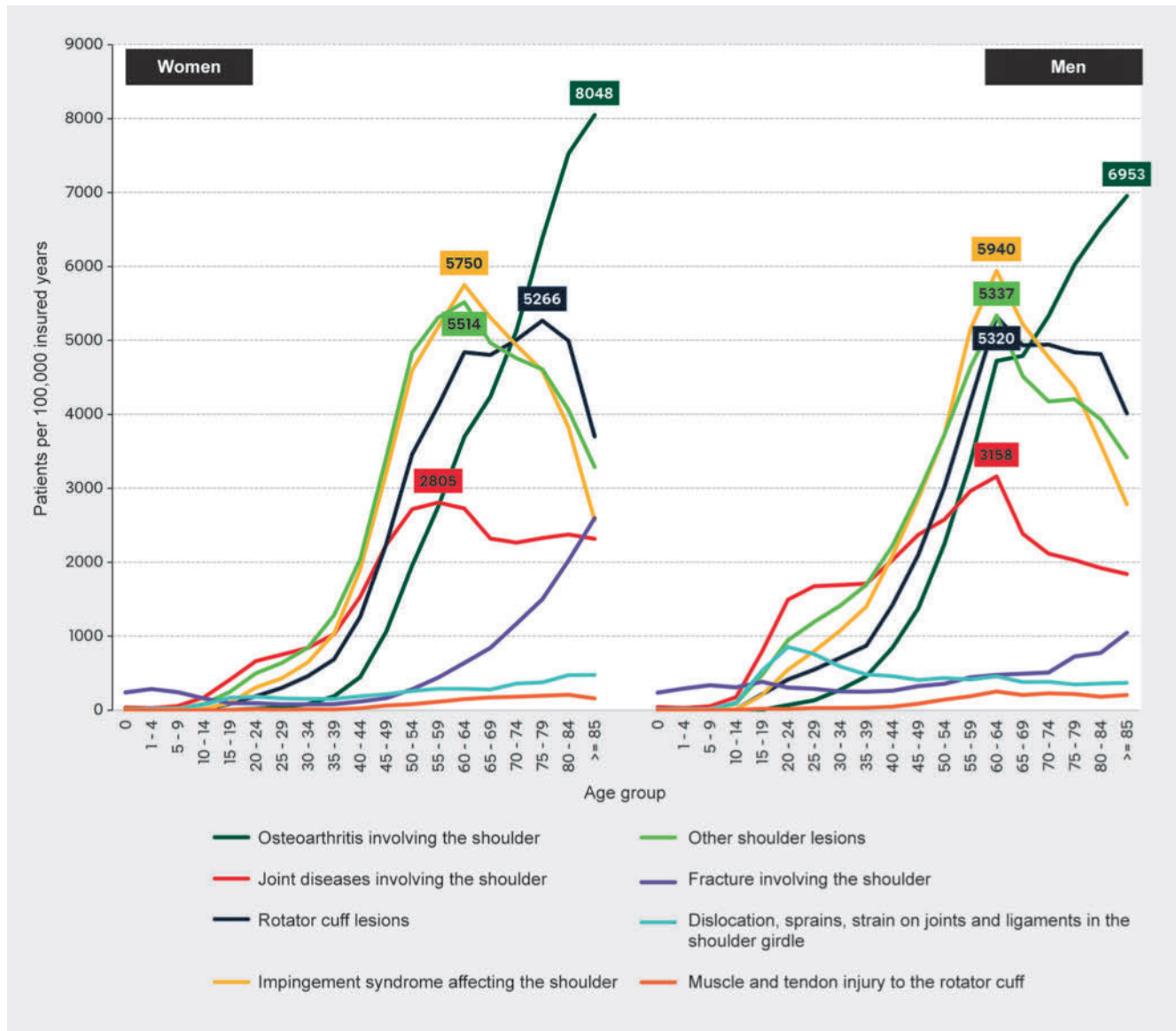
Coding behaviour

As ► **Fig. 2** shows, the diagnoses for degenerative shoulder disease and shoulder injuries are mainly coded by general practitioners. The percentage of diagnoses coded by orthopaedic or surgical specialists is significantly lower.

While arthrosis of shoulder, joint diseases of shoulder, and injury of muscle(s) and tendon(s) of the rotator cuff of shoulder were coded mostly by general practitioners, orthopaedists predominantly coded rotator cuff lesions, impingement syndrome of shoulder, and dislocations, sprains, and strains. Surgeons predominantly coded post-traumatic conditions. ► **Fig. 2** shows incidental and prevalent treatment cases for both the outpatient and inpatient sector.

Incidence

► **Fig. 3** shows newly diagnosed shoulder injuries for the year 2022. It is notable that the number of shoulder fractures increases significantly later in men compared to women and that, overall, women sustain a shoulder fracture significantly more often than



► **Fig. 1** Prevalence rates (number of insured persons affected per 100 000 number of years insured) of persons insured by AOK Baden-Württemberg for degenerative and traumatic diseases of the shoulder according to gender in 2022. The numbers in bold show the most affected age group.

men. Dislocations, however, occur predominantly in men, peaking significantly in youth and early adulthood.

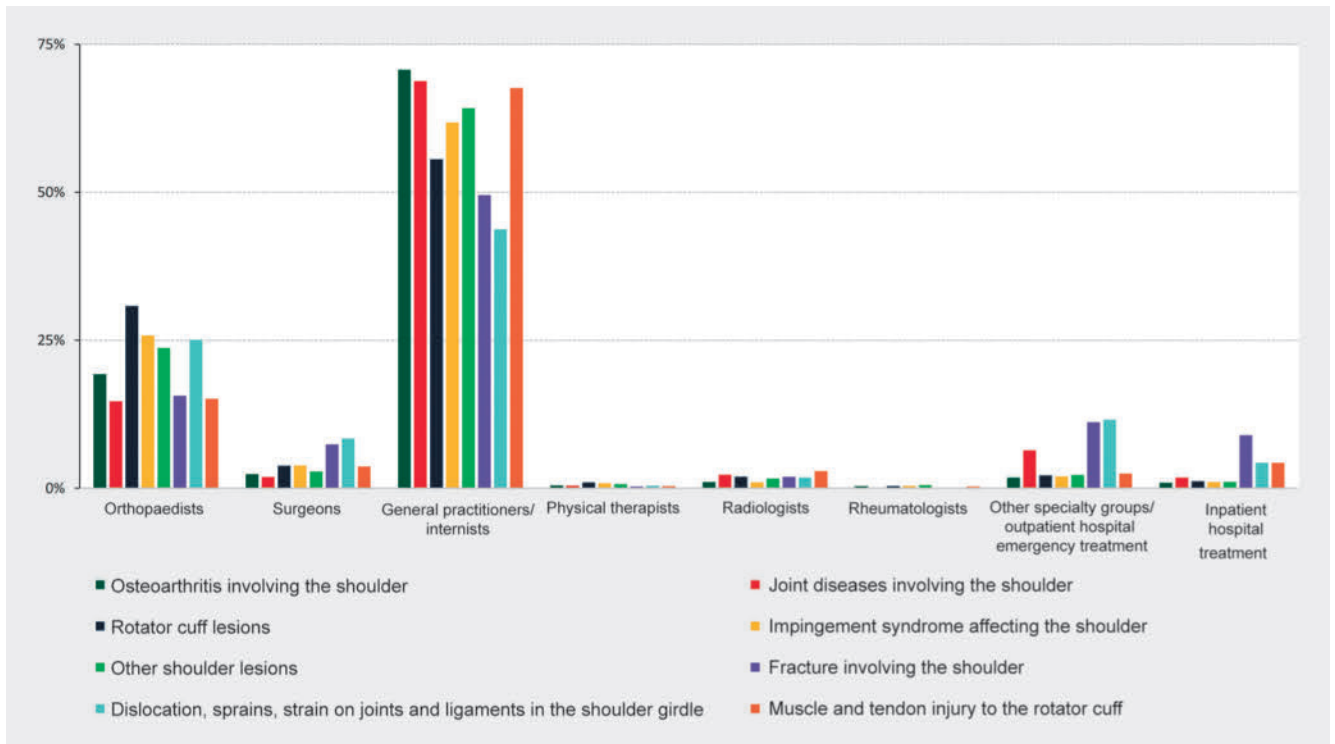
Utilisation of care services

In the period covered by the study, 26% of patients were examined with diagnostic imaging to diagnose degenerative shoulder disease (see ► **Fig. 4**). With the exception of the diagnosis “joint diseases of shoulder,” in all other investigated diagnosis groups diagnostic X-ray was performed in a mean of 19.9% of patients.

In most diagnosis groups, magnetic resonance imaging (MRI) was not carried out significantly more often than ultrasound examination. The total number of prescribed imaging procedures was lowest for the diagnosis “joint diseases of shoulder” and highest for the diagnosis “rotator cuff lesions.”

The evaluation of prescribed medications (► **Table 4**) showed that both the group of patients with shoulder injuries and the group of patients with degenerative disease were usually prescribed non-steroidal anti-inflammatory drugs (NSAIDs), with patients with shoulder injuries often also prescribed metamizole.

Physiotherapy prescriptions were also investigated (► **Fig. 5**). The data were first reviewed to see whether physiotherapy had been prescribed, irrespective of the recorded indication, and then reviewed again to find out which treatment was prescribed in the context of shoulder disease or injury. On average, 57% of patients were prescribed physiotherapy. When the physiotherapy data was reviewed along with indications on the prescription relating to a shoulder disorder, the mean figure was only 42% of patients.



► **Fig. 2** ICD coding behaviour according to medical specialist group or sector for persons insured by AOK Baden-Württemberg in the year 2022. Percentage of treatment cases for degenerative and traumatic diseases of the shoulder in relation to all treatment cases of the respective diagnosis groups.

► **Table 4** Percentages for the top 5 drugs affecting analgesia for persons insured by AOK BW with incidental degenerative disease of shoulder or incidental shoulder injury in 2022. The drugs were prescribed either in the same quarter as the diagnosis or in the following quarter.

3-digit ATC code for prescribed medicines	Degenerative shoulder disease	Traumatic shoulder disease
Anti-inflammatory and antirheumatic drugs	49%	45%
Remedies for acid-related disease	29%	32%
Metamizole sodium analgesics	27%	38%
Systemic corticosteroids	15%	16%
Other analgesics	13%	21%

Comorbidities

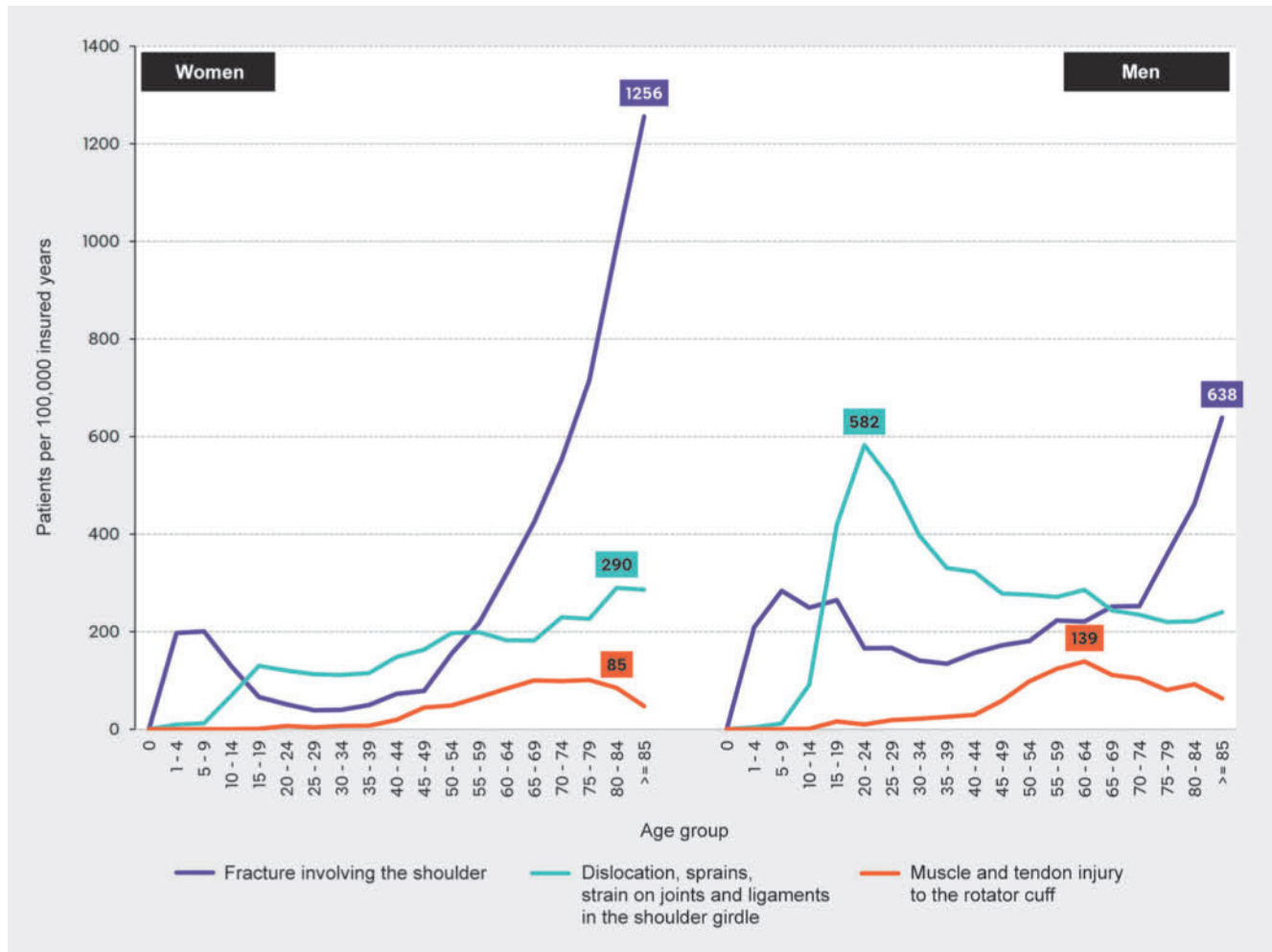
► **Fig. 6** shows the number of persons with disease per 100 000 number of insured years (IY) for patients with degenerative shoulder disease (comorbidity group 1) in 2022 per diagnosis group for the investigated comorbidities (a) diabetes mellitus, (b) hypertension, (c) thyroid gland disorder, and (d) lipoprotein metabolism disorder. Although the differences between individual di-

agnosis groups were limited, the comorbidity rates of persons with shoulder disease were clearly higher than those of the reference group.

The differences in comorbidity rates between the comorbidity groups 1–3 and the age- and gender-matched insured persons without shoulder disorders were reviewed for statistical significance. The results are statistically significant ($p < 0.01$). Cramer's V values were between 0.01 and 0.07, which indicates only a weak effect.

Discussion

Health insurance data from AOK BW were used for this study of the epidemiology, ICD-10 coding behaviour, and utilisation of therapies by persons with shoulder disease and shoulder injury. This data source has not been used before in Germany. The data shows that a significant increase in most degenerative diseases occurs in both genders in the age groups around the end of their working life. Comparatively, men tended to have slight injuries more often than women and usually at a younger age. This differed with regards to fractures. Both genders are similarly affected in younger years before the incidence drops again, to be followed by a strong increase. The increase is steeper in women and is already present from middle age. The largest percentage of coded diagnoses were coded by general practitioners who mainly used ICD-10 codes to code for symptoms, followed by medical specialists for orthopaedics and trauma surgery who tended to code for



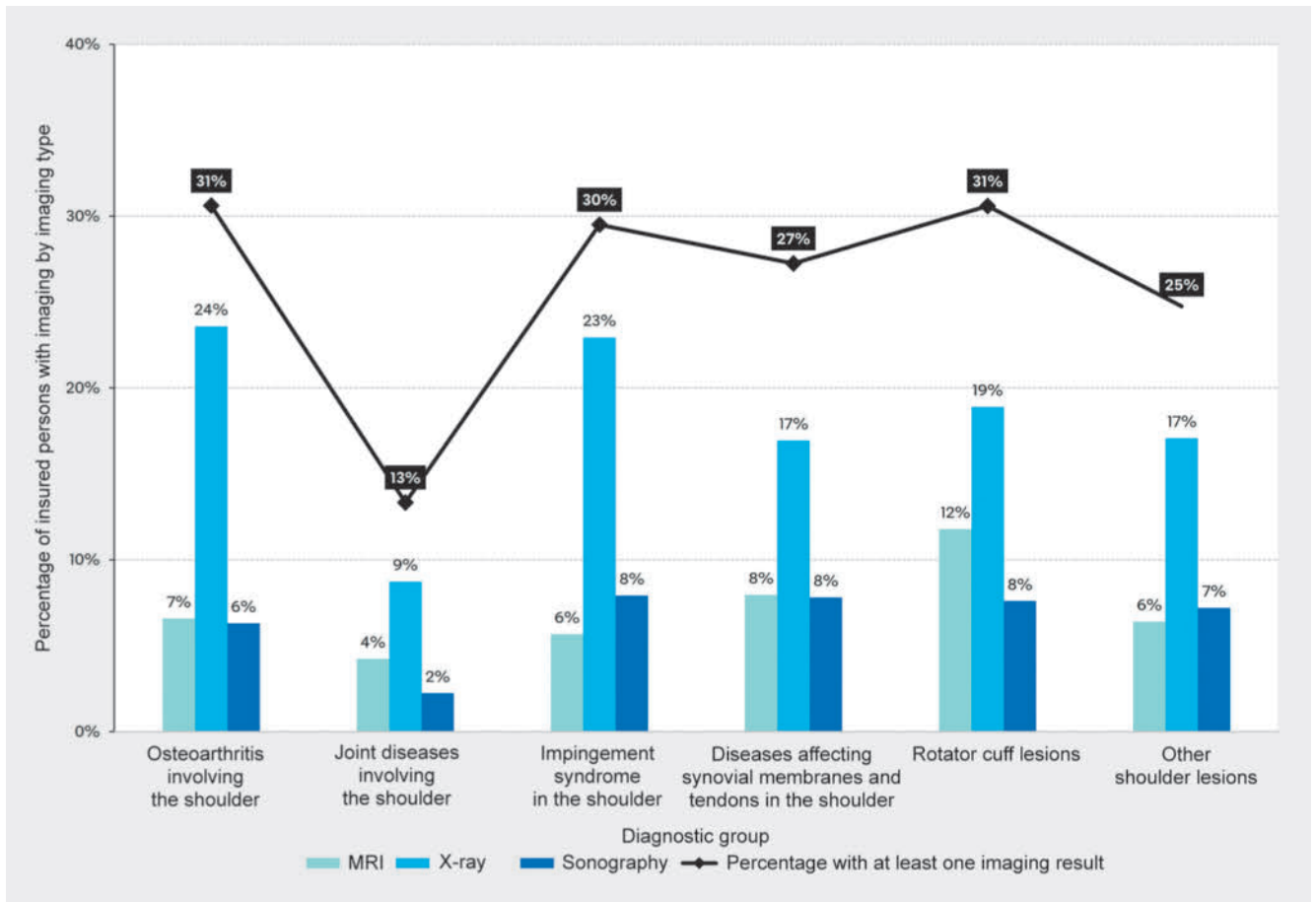
► **Fig. 3** Incidence rates of traumatic diseases of shoulder (number of newly diagnosed insured persons per 100,000 number of years insured) for persons insured by AOK Baden-Württemberg according to gender and age group in 2022. The figure in bold indicates the most severely affected age group.

the underlying causes of disease. Of the patients with newly developed disease or injury, around one quarter had diagnostic imaging and fewer than half had physiotherapy for shoulder disease. Insured persons with shoulder disease were more likely to have hypertension, metabolic disorders or lipid metabolism disorders compared to insured persons without shoulder disease.

This study shows the prevalence of degenerative shoulder joint disorders, which was found to peak in the 5th and 6th decades of life for impingement syndrome, rotator cuff lesions and other shoulder joint lesions. This largely corresponds to the findings of international studies [14, 15]. The findings for visits to a physician for shoulder pain differed from those reported in a Swedish study. The Swedish study reported only about half as many visits to a doctor (1%) compared to those reported in our data [16]. In a systematic review, Lucas et al. reported a wide prevalence range for the general population of between 0.7% and 55% and a treatment rate by a physician of between 1.0% and 4.8% [17]. A steep increase after the age of 40 was found for arthrosis of the shoulder, and this increase was even steeper in women than men. Clinical

studies of patients with shoulder pain found no difference between genders with regards to the prevalence of shoulder arthrosis [18], and the results in those studies did not differ greatly after standardising for age (2.0% men vs. 1.8% women). The overall prevalence was 21.2%, which was slightly lower than our findings of 28.7%. The higher percentage of women among the persons affected by shoulder disease could be explained by the higher life expectancy of women, as this clinical picture correlates with higher age [19].

The collected data revealed that dislocations of the shoulder joint occur mainly in men in adolescence and early adulthood. A review of previously published data shows that our results are comparable [20, 21, 22]. Although the findings can be plausibly explained by higher activity levels, higher occupational physical loads, a greater appetite for risk (e.g., in contact or extreme sports) or a greater alcohol consumption in men, these associations can only be assumed for our study as they are not documented by ICD-10 codes and can only be determined by carrying out patient surveys or smaller studies with only a few participants.



► **Fig. 4** Percentage of persons insured by AOK Baden-Württemberg whose diagnostic workup included imaging as part of their standard care for incidental degenerative shoulder disease according to diagnosis groups in 2022. The bars show the percentage of insured persons who had diagnostic imaging (sonography, X-ray, magnetic resonance imaging – MRI), although an insured individual might have several different imaging procedures. The curve indicates the percentage of insured persons who received at least one imaging procedure.

The current study also showed that the absolute number of affected women with shoulder fractures is higher than that of men and that the increase in the numbers of shoulder fractures in men starts significantly later than in women. It could be that earlier changes in bone density (osteoporosis) and an earlier decrease in coordination (increased propensity to fall) play a role [23]. A further aspect which could explain the higher number of women is possibly the prescription of medication (e.g., the analgesic pethidine, the antidepressant paroxetine, or the peripheral vasodilators pentoxifylline and nafronyl), which might also be associated with a higher risk of falling [24]. In Germany, these medications are included in the PRISCUS list. One study concluded that women are more frequently prescribed such medications than men [24]. The median age of the women in our study was 74 years and therefore significantly higher than that of the men (53 years). A higher age is correlated with a higher need for care which, in turn, could affect the prescription of potentially inappropriate medication and could be an explanation for the higher number of shoulder fractures in women.

The specificity of ICD-10 codes depends on the exactness of the diagnosis, and the diagnosis depends on the examiner's level

of medical knowledge and the availability of imaging methods and their interpretation. One limitation of the ICD-10 classification is that it defines some diseases based on individual symptoms but does not describe the pathomorphological cause. Especially for joint disease, the diagnoses “joint pain” and “impingement syndrome” are unspecific but are often coded. This is clearly confirmed in our study and is reflected by the fact that such unspecific ICD-10 codes were primarily coded by general practitioners. In contrast, medical specialists (orthopaedic or surgical) coded more specifically (e.g., rotator cuff lesions or (post-) traumatic conditions), and this was probably based on their having carried out a more detailed examination including functional tests and having more specific in-depth knowledge. However, it could also be due to the category of patients they examined. Patients who had contacted a general practitioner but then found that their painful symptoms healed spontaneously did not then require a visit to a medical specialist for a more detailed investigation into the cause of the pain.

It should be mentioned in this context that, in almost all diagnosis groups, instrument-based diagnostic procedures such as MRI examinations were not carried out significantly more often than

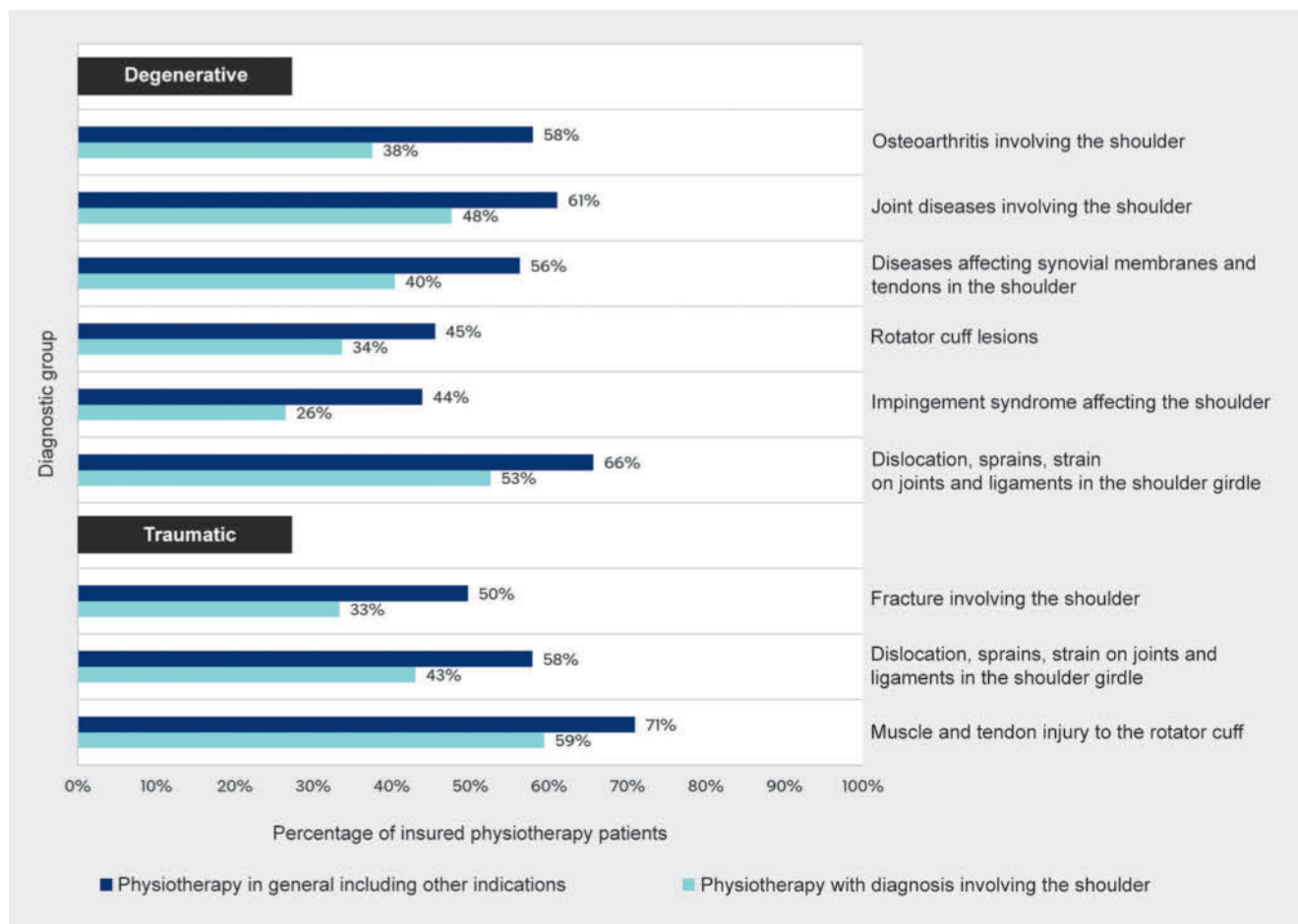


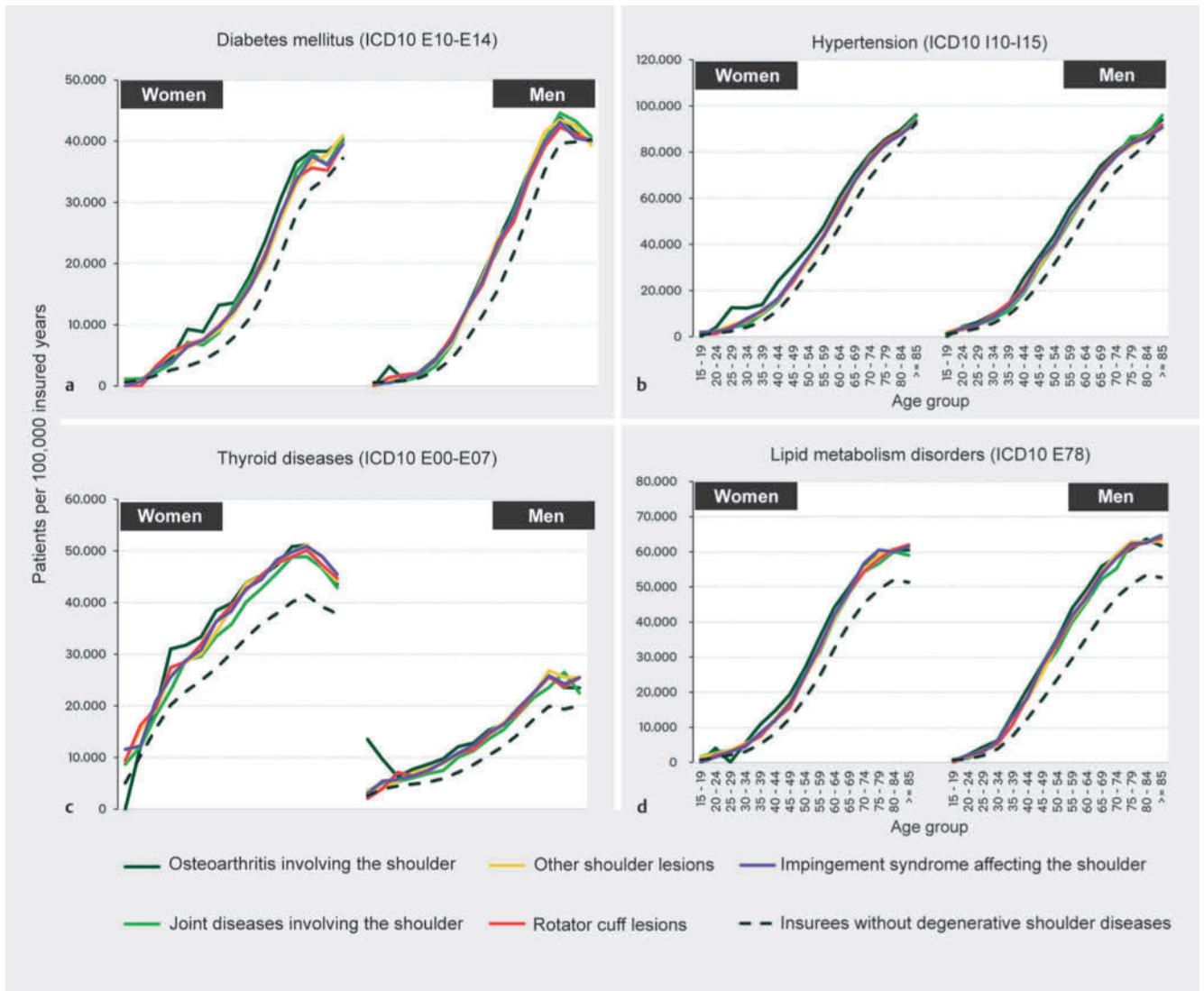
Fig. 5 Percentage of persons insured by AOK Baden-Württemberg who were prescribed physiotherapy for an incidental degenerative or traumatic shoulder disease according to diagnosis groups in 2022. The pale blue bar shows the percentage of insured persons who were prescribed physiotherapy based on an indication to treat shoulder disease/injury. The dark blue bar shows the percentage of all insured persons prescribed physiotherapy, irrespective of whether the indication was related to shoulder disease/injury or to another disease/injury. The pale blue bar is therefore always a subset of the dark blue bar.

ultrasound examinations. Unsurprisingly, diagnostic imaging was carried out less often for shoulder diseases with unspecific codes (e.g., joint pain or impingement) compared to cases with specific diagnoses. This could be connected to spontaneous healing or improvement of the pain, which meant that further visits to the doctor or diagnostic imaging were unnecessary. As several authors have reported, many patients have asymptomatic rotator cuff changes [4, 5, 6]. Our study can therefore not determine whether the morphological diagnosis (e.g., rotator cuff rupture) was the cause of the patient's clinical symptoms.

Our study also evaluated the billing of physiotherapeutic prescriptions. The study reviewed physiotherapy prescribed to treat shoulder disease as well as physiotherapy prescribed for other diagnoses. Surprisingly, only a little over 50% of patients in each diagnosis group were prescribed physiotherapy and just under 40% of patients were prescribed medication for a shoulder diagnosis. These data could reflect uncertainty on the part of the examiner when making the diagnosis or deciding on the appropriate therapy or could be a strategic approach to prescribing therapeutic mea-

asures in the face of known budgeting constraints relating to therapeutic care and the potential for claims to be made against the prescribing medical professional. However, another reason could also be failure to make use of prescribed therapy. In other words, the treating medical professional issued a prescription but the patient did not redeem it. Further studies should look at data on the utilisation of services in the context of surgical procedures and map out the course of treatment.

Age- and gender-matched standardisation was done prior to carrying out comparisons to determine the impact of comorbidities of the cardiovascular system and metabolic disorders, as these variables are relevant disturbance variables. We showed that patients with shoulder disease had disorders of the cardiovascular and metabolic system more often than the comparison group. Other studies have also investigated possible associations. After evaluating data in a systematic review, Burne et al. were able to show that patients with a metabolic syndrome had higher risk of rotator cuff lesions [25]. The results of the study by Zhao et al. identified hypertension as an additional risk factor [26].



► **Fig. 6** Prevalence rates (number of affected persons insured per 100 000 number of years insured) for persons insured by AOK Baden-Württemberg with (comorbidity group 1) and without degenerative shoulder disorders according to gender and age group in 2022. The prevalence rates for diabetes mellitus (a), hypertension (b), thyroid gland disorders (c), and lipoprotein metabolism disorders (d) are shown. The dotted lines show the prevalence rates for insured persons without degenerative shoulder disease (age-matched controls).

The following limitations should be noted with regards to this study: in contrast to primarily collected data, no bias, for example, recall bias or non-response, is expected in routine statutory health insurance data, which makes routine statutory health insurance data suitable for estimates of prevalence or incidence. However, this data still has certain limitations which need to be considered when using and interpreting results. As the data is entirely obtained from billing data and not from medical records, it is possible that the data may be of lower quality. Its validity cannot be conclusively assessed and precise operationalisation is not always possible because some data are missing [13]. Moreover, patients' lifestyles, sports activities, and physical stresses are additional relevant adjustment variables. But this information is not included in the billing data. When estimating prevalence based on billing data

it is important to be aware that the automatic coding of diagnoses in the computer-based information systems of surgeries or hospitals may lead to an overestimation of prevalence. It can also not be excluded that shoulder diagnoses are coded without clinical symptoms of a shoulder injury or disease being present. When looking at very large samples, the results of significance tests should always be reported together with the effect size, as very large samples are almost always statistically significant but this does not mean that the results are relevant [27]. Finally, it should be mentioned that the evaluated data from the year 2022 must be considered as conditional due to the COVID-19 pandemic and the possible related changes in the utilisation of services.

Conclusion

In our study, descriptive analysis was able to show the disease burden of a large percentage of the population of Baden-Württemberg and highlight the importance of shoulder disease, especially of degenerative shoulder disease. It would be useful if the not insignificant percentage of diagnoses coded using unspecific ICD-10 codes could be reduced and greater attempts made to arrive at a clear diagnosis. To this end, it could be useful to improve the training of general practitioners with regards to this issue, although this would be more time-consuming. A more consistent practice of referrals to a medical specialist would be beneficial. A better understanding of the real reasons why patients have recourse to healthcare services and a prompt and targeted diagnostic workup would lead to quicker initiation of therapeutic measures. This would allow studies of routine statutory health insurance data to be used better to determine specific disease burdens and make more targeted adjustments to healthcare structures.

This study can also serve as a basis for future, more specific questions, e.g., focusing on individual shoulder diseases with a high prevalence such as rotator cuff lesions or the impact of shoulder disease on employment or in the context of surgical care.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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