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ORIGINAL RESEARCH

Use of Non-Specific Knee Diagnoses and Incidence of Obscure Knee Injuries in a Large Government Health System

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Purpose: Within a large government health system, to assess the practice of using non-specific diagnoses for knee disorders and determine how often they appear as the only diagnosis without more specificity. The secondary purpose was to identify the incidence of obscure knee disorders diagnosed: pes anserine bursitis, prepatellar bursitis, pigmented villonodular synovitis, and plica syndrome.

Patients and Methods: Eligible beneficiaries of the Military Health System (MHS) seeking care for a knee disorder between 1 January 2009 and 31 December 2013 with at least 2-year follow-up. Data were sourced from the MHS Data Repository. The study outcomes were 1) utilization rate of non-specific knee diagnosis codes, 2) proportion of cases that never received a specific knee diagnosis, 3) incidence of obscure knee pathology in this cohort.

Results: There were 127,570 beneficiaries seeking care for knee pain during this period. While the majority (99.7%) initially received a non-specific knee diagnosis, these occurred in isolation for only 16.5% of the cases (n=20,042) over two-year follow-up. The use of non-specific codes was similar between military and civilian clinic settings (45.3% and 47.0%, respectively, of all knee disorders diagnosed), which appears to reflect clinical practice in which diagnoses become more specified over time and diagnostic workup aims to exclude competing diagnoses. The incidence of obscure knee pathology was small (0.2% to 4.0%).

Conclusion: Most of the cohort (99.7%) received a non-specific diagnosis at their initial visit, but only 15% did not eventually receive a more specific diagnostic code. These findings suggest that diagnoses may become more specific over time as condition-specific signs and symptoms become more evident, and diagnostic workup excludes competing diagnoses. A better understanding of diagnostic patterns and criteria for knee pain will improve the quality and interpretation from epidemiological studies.

Keywords: knee disorder, diagnosis, diagnostic criteria, musculoskeletal injury, health services research, electronic medical records

Introduction

Musculoskeletal injuries are highly prevalent in military populations, accounting for 91% of all disability-related medical separations from service during a soldier's first enlistment term, and 70% across the entire Army at large.[1] Of all forms of musculoskeletal injuries, knee injuries were responsible for the largest number of limited duty days in the US Army in 2017 and 2018.[2]

One challenge for properly understanding the burden of knee injuries and making determinations about the best treatment approaches is the ability to accurately identify specific types of knee disorders. Certain knee injuries are accompanied by a much higher health burden than others. Over 60% of all service members with patellofemoral pain required no further knee-related care during the two years following their initial visit within the health system,[3] suggesting a single visit was sufficient for most individuals. In contrast, meniscus injuries often lead to surgery and an

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inability to return to pre-injury levels of function in the military.[4] Outcomes following cruciate ligament injuries are similar to meniscus, with less than half of injured service members returning to duty without limitations.[5] However, non-specific diagnosis codes are often used in electronic medical records, which could affect the ability to properly identify attributable burden based on specific pathology.

While the most common knee injuries include patellofemoral pain, patellar tendinopathy, and insult to the meniscus, collateral ligaments, or cruciate ligaments, a wide range of knee conditions exist beyond these pathologies. Less is known about the incidence of more obscure knee conditions in military populations, which is in part due to an overall dearth of reporting on obscure conditions in the general population. To date, no epidemiological studies have reported normative population-level incidence or prevalence of conditions such as pigmented villonodular synovitis (PVNS), plica syndrome, prepatellar bursitis, or pes anserine bursitis. An important part of the differential diagnosis process is knowing the probability of a diagnosis,[6] and this is only possible with known incidence rates. Many of the well-known and more obscure diagnoses could be misrepresented based on coding practices that involve non-specific diagnoses.

Knowledge of the incidence of obscure knee conditions may be limited by the clinical practice of using non-specific diagnosis codes for knee complaints. The use of non-specific codes can limit the accurate measure of the incidence and prevalence of knee conditions in general. While it may also reflect normal clinical practice patterns associated with a diagnostic workup, understanding its use within a health system can strengthen the epidemiological framework for understanding the burden of knee injuries in general. The Military Health System (MHS) represents a unique case study, as one of the largest single-payer health systems in the United States. Service members and other beneficiaries of the TRICARE Health Maintenance Organization within the MHS are eligible for medical care at both military and private sector installations. Analysis of trends in coding for non-specific knee conditions within the MHS also presents an opportunity to identify differences in coding practices between the military and private sector.

To this end, the purpose of this retrospective study was to identify and report the incidence of obscure and non-specific knee diagnoses in the military population and compare medical coding practices for non-specific knee injuries between military and civilian clinics over the study period. Our findings will provide a better understanding of the overall burden of knee injuries in the military.

Materials and Methods

This was a longitudinal cohort study, with a retrospective assessment of data from electronic medical records and claims data. The study was reported according to the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) extension of the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) checklist, and was approved by the Institutional Review Board at Brooke Army Medical Center. Because data were all fully de-identified, the study was considered exempt and no consent from participants was required.

Setting and Participants

Participants were patients seeking care in the MHS for any knee condition classified under the Overuse Injury Index (OII) created by the Army Public Health Center.[7] The OII is part of a taxonomy created to categorize and characterize injuries in the MHS for surveillance purposes. To be included in the study cohort, an individual's medical record must be coded with an initial (index) knee diagnosis between 1 January 2010 and 31 December 2011. Within this cohort, cases coded with the index knee diagnoses of interest (listed below) were identified. The index knee diagnosis could occur in any setting (primary care or specialty provider) within a military or civilian clinic seeing TRICARE beneficiaries in the world. Individuals were eligible if continuously enrolled in TRICARE for 12 months before and two years following the index knee diagnosis. A 12-month lookback period was used to ensure no recent history of knee injury and to establish each case as a new episode of care. Individuals in the final cohort were followed for two years after the index knee diagnosis for co-occurring incidence of knee pathology. Individuals between the ages of 17 and 50 were included, as the best representation of the military population. While non-military personnel were included in the cohort (eg, spouses, dependents), the only 17-year-olds were on active duty, as emancipated minors, who can legally join military service under those conditions. Individuals with a co-occurring diagnosis of cancer or lower extremity amputation were excluded from the cohort.

Data Source

Data were sourced from the MHS Data Repository (MDR), which receives and validates data from medical records in military clinics and claims data from beneficiaries seeking care in civilian network clinics worldwide.[8] Data were received from a data analyst and assessed at the person-level and included encounters in both outpatient and inpatient military and civilian clinics where Tricare beneficiaries receive care. Data are entered raw and validated continuously across multiple other data sources for at least 90 days to address missing values so that the final outputs are robust with minimal missing data. The MHS is one of the largest health systems in the US, with military clinics and contracts with network civilian clinics all around the world.

Knee Diagnosis Variables

International Statistical Classification of Diseases and Related Health Problems, 9th Revision (ICD-9) codes were used to identify the study cohort, by including individuals with any of three non-specific knee diagnosis codes: [719.46 (pain in the joint, lower leg), 718.86 (Other joint derangement, not elsewhere classified, lower leg), 719.96 (Unspecified disorder of joint, lower leg)] or four obscure knee diagnoses [pes anserine bursitis (726.61), pigmented villonodular synovitis (PVNS) (719.26), prepatellar bursitis (726.65), plica syndrome (727.83)]. Description of the obscure diagnoses are listed in Table 1. All cases identified with a non-specific knee diagnosis code were queried for co-occurring obscure knee diagnosis codes. Finally, the study cohort was queried for co-occurrence of more common specified knee diagnoses (patellofemoral pain, patellar tendinopathy, collateral and cruciate ligament injuries, meniscus injury, knee fracture, knee dislocation, knee osteoarthritis) over two-year follow-up.

Statistical Analysis

The incidence of each initial knee diagnosis (non-specific or obscure, occurring within seven days of seeking initial care) was calculated as a proportion of all knee injuries and termed the index injury. The co-occurrence of non-specific or obscure knee diagnoses was also identified over a two-year period following the index knee diagnosis, allowing for the capture of both the index diagnosis and downstream obscure knee diagnoses during the subsequent two years. For individuals that received a non-specific index knee diagnosis, co-occurrence of selected common knee diagnoses was calculated to refine the incidence of non-specific knee diagnoses over a two-year follow-up period. In other words, cases were identified for which only a non-specific diagnosis was rendered without a more specific diagnosis. Finally, the use of non-specific diagnosis codes was compared between military and civilian clinics to determine if differences in coding patterns might be attributed to differences in clinical setting.

Table 1 Description of Obscure Knee Diagnoses

Plica Syndrome	Plicae represent the remnants of synovial tissue that divided the knee joint into separate compartments during early development.[9] While plicae may persist normally and remain asymptomatic, chronic inflammation in the setting of trauma, overuse, or other knee pathology can cause pathological thickening of the synovial plicae, leading to mechanical symptoms and synovitis.[9,10]
Pigmented Villonodular Synovitis (PVNS)	Pigmented villonodular synovitis is a rare condition of unknown etiology, thought to represent a benign proliferative lesion of the synovium, and most commonly involving the knee in 80% of the cases.[11]
Pes Anserine Bursitis	The pes anserine bursa is located anterior to the proximal medial tibia and deep to the insertion of the semitendinosus, gracilis, and sartorius tendons.[12] Pes anserine bursitis presents as medial knee pain with localized tenderness over the bursa, and is typically a clinical diagnosis.
Prepatellar Bursitis	The prepatellar bursa, located anterior to the patella, and the superficial infrapatellar bursa, anterior to the tibial tuberosity, are anatomically distinct but in practice, collectively referred to as the "prepatellar" bursa.[13] It commonly presents as anterior knee pain, with localized peripatellar tenderness.

Results

Of the 221,093 military beneficiaries with knee injuries between 1 January 2010 and 31 December 2011 with 36 months of continuous eligibility (12 months before, 24 months after), 127,570 individuals were identified with one of the knee diagnoses of interest and met all criteria for inclusion (Figure 1). The demographics of this final cohort include a mean age of 34.6 years (SD 9.1), 34.2% female, 65.0% on active duty, and 46.3% with the US Army as the sponsor's service (Table 2).

Of all the obscure and non-specific diagnoses assessed in this cohort, the non-specific diagnosis of knee joint pain (Pain in joint, lower leg) was the most common index diagnosis, present in 99.7% of all cases (Table 2). Among obscure knee pathology, an index diagnosis of pes anserine bursitis was coded for 873 cases (0.7%), PVNS for 8 cases (<0.0%), prepatellar bursitis for 1154 cases (0.9%), and plica syndrome for 265 cases (0.2%; Table 2). The incidence rate of these diagnoses increased over a two-year follow-up period (Table 3), to 1816 cases for pes anserine bursitis (1.4%), 537 cases for PVNS (0.4%), 1835 cases for prepatellar bursitis (1.4%) and 2513 cases for plica syndrome (2.0%). Non-specific knee joint pain remained the most common diagnosis over two years of follow-up, accounting for 98.9% of all cases (Table 3).

Over two years of follow-up, the non-specific knee joint pain diagnosis occurred in isolation for 16.5% of the cases (n=20,042; Table 4). Co-occurrence of obscure knee diagnoses with non-specific knee joint pain over two years of follow-up yielded 616 cases of pes anserine bursitis (33.9% of all pes anserine bursitis cases), 329 cases of PVNS (61.3% of all PVNS cases), 490 cases of prepatellar bursitis (26.7% of all prepatellar bursitis cases), and 1226 cases of plica syndrome (48.8% of all plica syndrome cases; Table 4). Finally, among more common specified knee conditions, the most prevalent knee diagnoses co-occurring with non-specific knee joint pain were chondromalacia patella (98,662), followed by knee osteoarthritis (8940) and meniscus injury (8136).

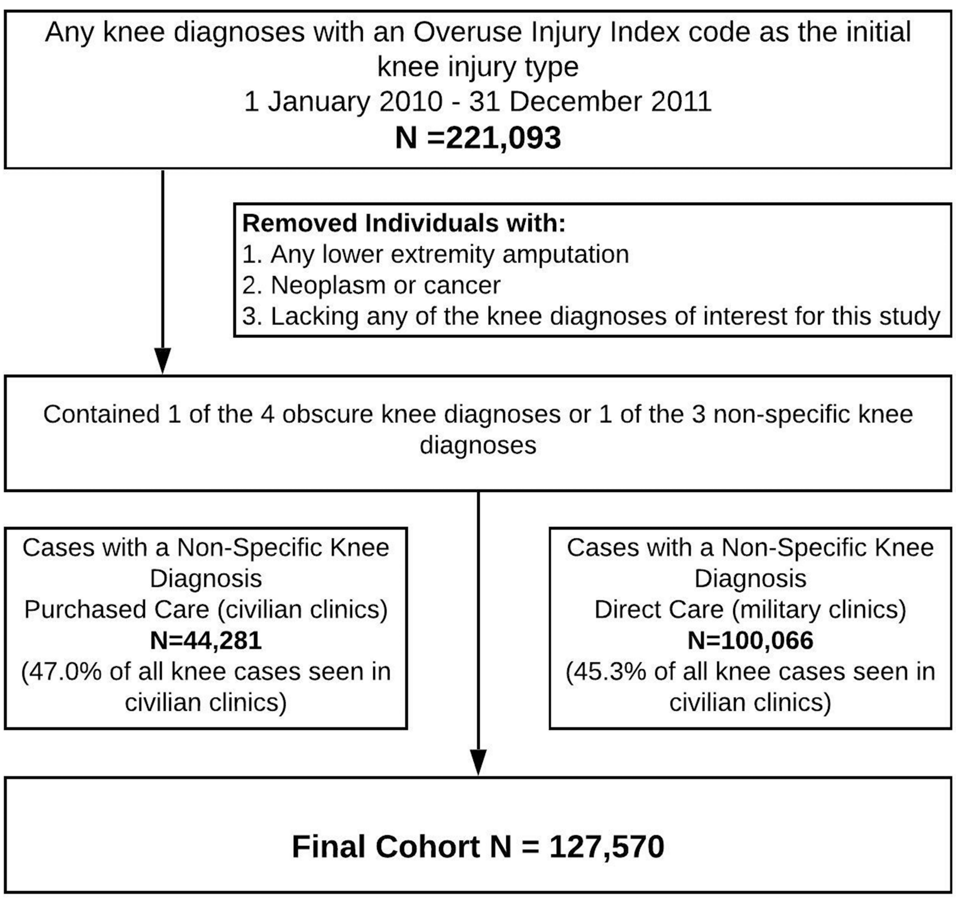

Figure 1 Cohort selection.
Notes: Sum of cases in purchased and direct care is greater than the final cohort number because some individuals were seen in both military and civilian clinics.

Table 2 Index Obscure and Non-Specific Knee Diagnoses

	Total Cohort N=127,570	Pes Anserine Bursitis n=873 (0.7)	Villonodular Synovitis n=8 (0.0)	Prepatellar Bursitis n=1154 (0.9)	Plica Syndrome n=265 (0.2)	Non-Specific Diagnoses		
						Pain in Joint, Lower Leg n=121,187 (99.7)	Other joint Derangement Not Elsewhere Classified n=79 (0.1)	Unspecified Disorder of the Joint in the Lower Leg n=28 (0.0)
Mean Age (SD)	34.6 (9.1)	36.7 (9.3)	37.1 (11.0)	34.5 (9.2)	33.1 (8.6)	22.6 (9.1)	34.9 (9.8)	39.4 (8.9)
Female Sex	43,471 (34.2)	372 (42.6)	6 (75.0)	288 (25.0)	87 (33.2)	41,583 (34.4)	28 (35.4)	16 (57.1)
Beneficiary Status								
– Active Duty	82,945 (65.0)	488 (55.9)	4 (50.0)	726 (62.9)	183 (69.1)	78,248 (64.7)	41 (51.9)	9 (32.1)
– Dependent	32,847 (25.7)	291 (33.3)	4 (50.0)	274 (23.7)	63 (23.8)	31,535 (26.0)	27 (34.2)	15 (53.6)
– Retired Service Member	11,311 (8.9)	94 (10.8)	0	152 (13.2)	16 (6.0)	10,855 (9.0)	11 (13.9)	4 (14.3)
– Other	467 (0.4)	0	0	2 (0.2)	3 (1.1)	449 (0.4)	0	0
Service*								
– Army	59,011 (46.3)	325 (37.2)	1 (12.5)	427 (37.0)	126 (47.5)	56,250 (46.4)	39 (49.4)	11 (39.3)
– Air Force	34,452 (27.0)	315 (36.1)	4 (50.0)	319 (27.6)	53 (20.0)	32,582 (26.9)	11 (14.9)	11 (39.3)
– Navy	21,417 (16.8)	175 (20.0)	3 (37.5)	288 (25.0)	55 (20.8)	20,238 (16.7)	17 (21.5)	3 (10.7)
– Marines	9660 (7.6)	35 (4.0)	0	89 (7.7)	26 (9.8)	9218 (7.6)	10 (12.7)	3 (10.7)
– Coast Guard	2742 (2.1)	22 (2.5)	0	26 (2.3)	5 (1.9)	2620 (2.2)	1 (1.3)	0
– Other/Unknown	287 (0.2)	1 (0.1)	0	5 (0.4)	0	278 (0.2)	1 (1.3)	0
Socioeconomic Status*								
– Junior Enlisted	44,753 (35.1)	264 (30.2)	2 (25.0)	412 (35.7)	91 (34.3)	42,280 (34.9)	21 (26.6)	4 (14.3)
– Senior Enlisted	57,417 (45.0)	414 (47.4)	5 (62.5)	499 (43.2)	110 (41.5)	54,725 (45.2)	37 (46.8)	15 (53.6)
– Junior Officer	11,642 (9.1)	79 (9.0)	0	104 (9.0)	28 (10.6)	11,065 (9.1)	7 (8.9)	1 (3.6)
– Senior Officer	13,175 (10.3)	109 (12.5)	1	126 (10.9)	29 (10.9)	12,589 (10.4)	14 (17.7)	8 (28.6)
– Cadet	537 (0.4)	6 (0.7)	0	12 (1.0)	7 (2.6)	487 (0.4)	0	0
– Other/Unknown	1 (0.1)	1 (0)	0	1 (0.1)	0	42 (0)	0	0
Race								
– White	65,499 (51.3)	455 (52.1)	4 (50.0)	678 (58.8)	153 (57.7)	62,118 (51.3)	41 (51.9)	11 (39.2)
– Black	24,022 (18.8)	102 (11.7)	0	159 (13.8)	40 (15.1)	22,705 (18.7)	10 (12.7)	4 (14.3)
– Asian or Pacific Islander	7174 (5.6)	48 (5.5)	0	69 (6.0)	7 (2.6)	6805 (5.6)	2 (2.5)	0
– Native American	1195 (0.9)	6 (0.7)	0	10 (0.9)	5 (1.9)	1127 (0.9)	2 (2.5)	1 (3.6)
– Other	5677 (4.5)	47 (5.4)	0	42 (3.6)	10 (3.8)	5372 (4.4)	4 (5.1)	0
– Unknown	24,003 (18.8)	215 (24.6)	4 (50.0)	196 (17.0)	50 (18.9)	23,060 (19.0)	20 (25.3)	12 (42.9)

Notes: Values reported as N (% within column). *Sponsor status is based on the active-duty service member, even for spouse or dependents.

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Table 3 Cumulative Obscure and Non-Specific Diagnoses Over Two-Year Follow-Up

Total Cohort N=127,570	**Pes Anserine Bursitis n=1816 (1.4)**	**Pigmented Villonodular Synovitis n=537 (0.4)**	**Prepatellar Bursitis n=1835 (1.4)**	**Plica Syndrome n=2513 (2.0)**	**Non-Specific Diagnoses**		
					Pain in Joint, Lower Leg n=126,170 (98.9)	**Other Joint Derangement Not Elsewhere Classified n=1353 (1.1)**	**Unspecified Disorder of the Joint in the Lower Leg n=806 (0.6)**
Mean Age (SD)	36.4 (9.1)	37.8 (8.9)	34.8 (9.3)	34.7 (8.7)	34.6 (9.1)	34.2 (8.7)	37.1 (8.9)
Female Sex	813 (44.8)	202 (37.7)	481 (26.3)	715 (28.5)	42,990 (34.2)	471 (34.9)	282 (35.0)
Beneficiary Status*							
– Active Duty	1114 (61.3)	281 (52.3)	1162 (63.3)	1797 (71.5)	82,139 (65.1)	899 (66.4)	470 (58.3)
– Dependent	548 (30.2)	174 (32.4)	426 (23.2)	510 (20.3)	32,429 (25.7)	344 (25.4)	235 (29.2)
– Retired Service Member	154 (8.5)	81 (15.1)	244 (13.3)	199 (7.9)	11,138 (8.8)	108 (8.0)	100 (12.4)
– Other	0	1 (0.2)	3 (0.2)	7 (0.3)	464 (0.4)	2 (0.1)	1 (0.1)
Service*							
– Army	692 (38.1)	191 (35.6)	680 (37.1)	1105 (44.0)	58,492 (46.4)	605 (44.7)	365 (45.3)
– Air Force	643 (35.4)	180 (33.5)	546 (29.8)	761 (30.3)	34,042 (27.0)	353 (26.1)	250 (31.0)
– Navy	354 (19.5)	86 (16.0)	405 (22.1)	394 (15.7)	21,075 (16.7)	226 (16.7)	133 (16.5)
– Marines	78 (4.3)	59 (11.0)	133 (7.2)	191 (7.6)	9564 (7.6)	114 (8.4)	37 (4.6)
– Coast Guard	47 (2.6)	20 (3.7)	62 (3.4)	59 (2.3)	2709 (2.1)	50 (3.7)	19 (2.4)
– Other/Unknown	2 (0.1)	1 (0.2)	9 (0.5)	3 (0.1)	287 (0.2)	5 (0.4)	2 (0.2)
Socioeconomic Status*							
– Junior Enlisted	566 (31.2)	141 (26.3)	658 (35.9)	820 (32.6)	44,297 (35.1)	468 (34.6)	207 (25.7)
– Senior Enlisted	852 (46.9)	300 (5.9)	814 (44.4)	1149 (45.7)	56,794 (45.0)	619 (45.8)	448 (55.6)
– Junior Officer	174 (9.6)	31 (5.8)	159 (8.7)	272 (10.8)	11,508 (9.1)	106 (7.8)	63 (7.8)
– Senior Officer	215 (11.8)	62 (11.5)	183 (10.0)	247 (9.8)	13,011 (10.3)	157 (11.6)	87 (10.8)
– Cadet	8 (0.4)	1 (0.2)	20 (1.1)	23 (0.9)	514 (0.4)	3 (0.2)	0
– Other/Unknown	1 (0.1)	2 (0.4)	1 (0.1)	2 (0.1)	46 (0)	0	1 (0.1)
Race							
– White	936 (51.5)	293 (54.6)	1073 (58.5)	1582 (63.0)	64,722 (51.3)	743 (54.9)	413 (51.2)
– Black	260 (14.3)	82 (15.3)	269 (14.7)	321 (12.8)	23,859 (18.9)	214 (15.8)	156 (19.4)
– Asian or Pacific Islander	98 (5.4)	15 (2.8)	97 (5.3)	101 (4.0)	7097 (5.6)	71 (5.2)	30 (3.7)
– Native American	16 (0.9)	6 (1.1)	18 (1.0)	32 (1.3)	1179 (0.9)	24 (1.8)	8 (1.0)
– Other	90 (5.0)	19 (3.5)	66 (3.6)	95 (3.8)	5621 (4.5)	46 (3.4)	26 (3.2)
– Unknown	416 (22.9)	122 (22.7)	312 (17.0)	382 (15.2)	23,692 (18.8)	255 (18.8)	173 (21.5)

Notes: Values reported as N (% within column). *Sponsor status is based on the active-duty service member, even for spouse or dependents.

Table 4 Proportion and Occurrence of Specified Knee Conditions Among Non-Specific Knee Diagnoses Over Two-Year Follow-Up

Pes Anserine Bursitis (%)	Non-Specific Diagnoses		
	Pain in Joint, Lower Leg n=121,187	Other Joint Derangement Not Elsewhere Classified n=79	Unspecified Disorder of the Joint in the Lower Leg n=28
Villonodular Synovitis (%)	616 (33.9)	1	0
Prepatellar Bursitis (%)	329 (61.3)	0	1
Plica Syndrome (%)	490 (26.7)	0	11
Chrondromalacia Patella	1226 (48.8)	1	
Patellar Tendinopathy	98,662	22	5
Lateral Collateral Ligament Injury	3318	4	0
Medial Collateral Ligament Injury	359	1	0
Knee Fracture	1005	0	0
Knee Dislocation	154	1	0
Knee Osteoarthritis	584	1	0
Cruciate Ligament Injury	8940	11	7
Meniscus Injury	1843	9	0
Isolated Non-Specific Diagnosis without Any Other Knee-Specific Diagnoses	8136	12	2

Note: (%) represents the percent out of each obscure knee diagnosis total with a co-occurring non-specific knee diagnosis.

The use of non-specific codes was similar between military and civilian settings, comprising 47.0% and 45.3% of all knee cases seen during this period in civilian and military clinics, respectively (Figure 1). Within the final cohort, 44,481 and 100,060 cases received a non-specific diagnosis in a civilian or military clinic, respectively. Note that the sum of these cases is greater than the final cohort size, as certain patients were seen in both military and civilian clinics.

Discussion

The findings from this military cohort highlight the preferential use of non-specific diagnosis codes for initial knee injuries in a large majority of patients receiving care within the MHS (99.7%). Over two-year follow-up, most of these individuals received a more definitive, specified knee diagnosis, but approximately 15% remain classified with only a non-specific knee diagnosis code. In this cohort, the incidence of more obscure knee pathology was relatively rare, occurring in only 0.4–2.0% of all individuals presenting with knee pain. The majority of these more obscure cases were not coded initially as such. Instead, the diagnoses were rendered during the two-year follow-up period, which may reflect the time needed for diagnostic workup and management to determine the underlying cause for the knee injury and exclude other conditions. This highlights 2 important points for consideration when using this data for epidemiological research. First, the incidence of obscure knee diagnoses more than doubled when looking longitudinally beyond the index date, and second, while the use of non-specific knee diagnoses was very high (99.7% of all patients), the large majority (~85%) went on to receive a more specific knee diagnosis when followed over their course of care. Following cases longitudinally will likely improve the homogeneity of cohort selection for individuals with knee disorders.

In this context, findings of initial non-specificity are certainly plausible. They may reflect early uncertainty of the presentation, requiring a clinician to pursue further diagnostic workup to narrow the differential diagnosis and specify the underlying condition. In this setting, non-specific diagnoses could serve as placeholders, whereas other tests such as radiographs or laboratory tests are ordered to rule out competing diagnoses (eg, septic arthritis, occult fracture, more common cruciate or meniscus injury).[9] In certain cases, the passage of time can itself lead to a more accurate diagnosis. Acute pain or swelling can limit the extent of a physical examination. Allowing for symptoms to stabilize or effusion to diminish with time can yield more extensive assessment of knee function and disability. Further, as cases progress to specialty care, the specificity of diagnosis may improve. Our findings appear to reflect clinical practice, since coding for obscure knee diagnoses increased 2–10-fold from the initial diagnostic time period (within seven days of first seeking care) over two years of follow-up. Finally, another explanation is that some clinicians may not feel adequate or confident enough to use specific diagnostic labels. Past work has emphasized an overall lack of training in musculoskeletal medicine in medical residencies.[10,11] Further qualitative and prospective research designed to better answer questions about the factors that drive the use of non-specific diagnostic labels is warranted.

The incidence of obscure knee pathology is helpful for establishing epidemiological normative values expected in this setting and within this population. No prior epidemiological studies were identified that reported population-level incidence of the obscure knee conditions evaluated in this study, relative to more common injuries. The most common knee injury in our final cohort was chondromalacia patella or patellofemoral pain. Approximately 80% of this cohort was diagnosed with chondromalacia patella, representing four out of every five knee injuries. In contrast, the highest incidence among the more obscure knee conditions was 2.0% for plica syndrome.

Prepatellar Bursitis

Bursae are synovium-lined sac-like structures that help reduce friction in areas of high contact between bones, ligaments, and muscles.[12] Despite their efforts to mitigate friction, bursae remain susceptible to inflammation, most commonly due to overuse, but also occur secondary to systemic disease or septic arthritis.[13,14] Diagnosis of prepatellar bursitis is typically clinical but may require aspiration to exclude septic bursitis. Current literature is void of quality studies investigating gold standard diagnosis and effective interventions for prepatellar bursitis, so consensus guidelines for optimal treatment do not exist.[15] Moreover, few epidemiological studies exist for prepatellar bursitis, so its overall incidence and prevalence are unknown in the general population. In one study of university wrestlers over a six-year period, prepatellar bursitis was the most common injury sustained by these athletes, representing 21% of all initial episodes of knee injuries.[16]

Plica Syndrome

Diagnosis for plica syndrome may be clinical or require magnetic resonance imaging or arthroscopy. Non-surgical treatment can be as effective as surgery.[17] One study of 3889 knee joints in 3563 individuals undergoing knee arthroscopy reported a 79.9% incidence rate of medial plicae across all age groups and genders.[18] This study did not specify if the etiology of symptoms for these patients was pathological plicae, so the incidence of plicae does not directly translate to that of plicae syndrome. In contrast to a symptomatic population undergoing arthroscopy, the incidence of plicae in the general population has been reported to be approximately 10–20% from surgical or cadaveric studies,[19] with most plicae being asymptomatic, suggesting the true incidence of plica syndrome to be much less than 20%. Within our military cohort, we report the cumulative incidence of plica syndrome to be 2.0%, out of all individuals seeking care for knee pain during the study period.

Pigmented Villonodular Synovitis

The clinical presentation of PVNS is often non-specific, requiring advanced imaging, synovectomy, and histological confirmation of diagnosis. Its incidence is estimated to be 1.8 cases per million across all joint and tendon sites,[20] in an analysis of 190 lesions with microscopic evaluation of pathology. We report a 0.4% cumulative incidence of PVNS in our military cohort out of all individuals seeking care for knee pain during the study period.

Pes Anserine Bursitis

The prevalence of pes anserine bursitis as detected on MRI was reported to be 2.5% from a retrospective review of 509 knee MRI studies obtained for 488 patients who presented with knee pain.[21] In comparison, the cumulative incidence of pes anserine bursitis in our military cohort was 1.4% out of all individuals seeking care for knee pain during the study period.

Implications for Research and Clinical Practice

These findings demonstrate that clinical practice patterns should be considered when performing epidemiological studies that identify cohorts based on diagnostic coding used in medical records. Indeed, the index diagnosis may not represent the definitive diagnosis. Studies with lookback periods that exclude cases of knee disorders prior to the one specific diagnosis of interest may be excluding relevant cases that have not yet received the definitive diagnosis of interest. In some scenarios, the initial care-seeking event that resulted in the non-specific diagnosis could be the incident case of interest. This should be considered in future studies of this nature. Following a cohort over a period of time, rather than a cross-sectional snapshot, may allow for improved specificity of knee conditions, by excluding heterogenous or outlier cases that may change over time. Regardless, non-specific diagnostic coding is likely to still persist for certain cases. The specificity of diagnoses could vary based on clinical specialty. For example, the majority of non-specific diagnosis codes may occur at initial primary care visits, while specified knee diagnoses are more likely to be rendered by specialists at follow-up time points (eg, orthopaedists, physical therapists, physiatrists). Future epidemiological studies using health systems data should also explore trends in specificity of coding following the transition from ICD-9 to ICD-10, representing an increase from approximately 17,000 to more than 150,000 codes.[22] Whether the expansion in number and specificity of codes will translate to increased specificity of medical coding remains to be seen.

Limitations

These data represent patterns seen in a closed single-payer government health system for adults 50 years of age and under, which may not be generalizable to other healthcare systems or settings. The validity of diagnostic coding cannot be verified, as diagnostic criteria and thresholds are likely to vary by setting and by clinician, suggesting heterogeneity among cases may exist with the same diagnostic coding. While third-party payer systems may have a greater reliance on specific diagnostic billing and coding for reimbursement, the incidence of non-specific coding was no different in claims data from civilian clinics than in military clinics. While the use of non-specific diagnosis codes has implications on epidemiological research findings, their use in clinical practice may remain acceptable for reimbursement purposes. Finally, this cohort includes only the individuals with one year of eligibility prior to index diagnosis and two years following. Individuals who separated or retired from military service or became otherwise ineligible for care within the MHS during the two-year follow-up period were excluded, and it is probable that injury rates among these individuals were higher, given the known impact of orthopaedic injuries on separation from service. Likewise, military trainees are unlikely to be represented in this cohort due to the requirement for one year of eligibility prior to index diagnosis.

Conclusion

In this care-seeking cohort of 127,570 MHS beneficiaries, the incidence of obscure knee pathology was very small. All four obscure diagnoses (PVNS, prepatellar bursitis, pes anserine bursitis, and plica syndrome) occurred in ≤2% of the entire cohort (range 0.4% to 2.0%). The majority of the cohort (99.7%) received a non-specific diagnosis at their initial visit, but only 15% did not receive a more specific diagnostic code when followed longitudinally. The use of non-specific codes was similar between cases seen in military and civilian (45.3% and 47.0%, respectively, of all knee disorders seen during this time). These findings suggest that diagnoses become more specific over time as condition-specific signs and symptoms become more evident, and diagnostic workup excludes competing diagnoses. To our knowledge, our study is the first to report the incidence of plica syndrome, PVNS, and pes anserine and prepatellar bursitis in the Military Health System. Future epidemiological studies should implement longitudinal designs to better account for improved specificity of diagnoses and cohort homogeneity.

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