Pain Physician 2020; 23:E429-E439 • ISSN 2150-1149

Cross-Sectional Analysis

A Burden and Prevalence Analysis of Chronic Pain by Distinct Case Definitions among Active Duty U.S. Military Service Members, 2018

Hunter Jackson Smith, MD[1], Stephen B. Taubman, PhD[2], and Leslie L. Clark, PhD[2]

From: [1]Department of Preventive Medicine and Biostatistics, Uniformed Services University, Bethesda, MD; [2]Epidemiology and Analysis Section, Armed Forces Health Surveillance Branch, Silver Spring, MD

Address Correspondence:
Hunter Jackson Smith, MD
Department of Preventive Medicine and Biostatistics
Uniformed Services University
4301 Jones Bridge Rd.
Bethesda, MD 20814
E-mail:
hunter.j.smith32.mil@mail.mil

Manuscript received: 01-28-2020
Revised manuscript received: 03-26-2020
Accepted for publication: 04-08-2020

Free full manuscript:
www.painphysicianjournal.com

Background: Chronic pain is a growing problem in the military, and the methods by which we have to perform epidemiologic surveillance are insufficient. It represents both a public health and military readiness concern, as those who suffer from it experience adverse impacts on work productivity, physiological health, and quality of life.

Objectives: This study was designed to assess the prevalence of chronic pain among active component military service members utilizing 2 distinct, published case definitions. It sought to describe the demographics and military characteristics of those receiving chronic pain diagnoses. The study also aimed to provide improved granularity regarding military chronic pain patients' pain severity and its impacts on their job performance.

Study Design: Cross-sectional analysis for 2018.

Setting: This analysis utilized data available from the Defense Medical Surveillance System, a database containing longitudinal data on service members.

Methods: Patients: The surveillance population consisted of all active component service members from the U.S. Army, Navy, Air Force, and Marines of all grades serving at any point during the surveillance period of January 1, 2018 through December 31, 2018.

Measurement: Diagnoses were ascertained from the administrative records of all medical encounters of individuals who received care through the Military Health System or civilian referrals. Data from patients' Periodic Health Assessment (PHA) encounters were also utilized to derive more granular data regarding their experiences of pain.

Results: Case Definition 1, more specific for identifying chronic pain, identified a more severe subset of chronic pain patients when compared against Case Definition 2, a more comprehensive method for identifying potential chronic pain patients. Case Definition 1 found a higher prevalence of impactful pain (CD1: 36.7% vs. CD2: 23.5%), and Case Definition 1 patients are more likely to be on limited duty and require treatment related to their pain. Several demographic groups were also found to be at increased risk of chronic pain diagnosis, including women, black non-Hispanic, Army, older age, and enlisted.

Limitations: First, in utilizing administrative data, this allows for the possibility of misclassification bias. Second, some deployment data still used ICD-9 coding even in 2018, resulting in a minor underestimation by approximately 30 patients and approximately 60 encounters. Third, the prevalence estimates for the demographics were not adjusted for potential confounders.

Conclusions: Chronic pain has been difficult to define via administrative and screening data, and as such its burden and prevalence estimates can vary considerably depending on which case definition is used. This is of particular importance in the U.S. military, as these estimates can significantly impact our calculations for force readiness and the protection of our national security. To our knowledge, this study is the first of its kind to examine chronic pain across the entirety of the U.S. armed forces and to utilize granular, annually collected PHA data in this way. The results of this exploratory analysis could be used as a template to better characterize the burden of chronic pain from a population-based perspective and monitor the effectiveness of pain management strategies.

Key words: Chronic pain, military, case definition, surveillance, epidemiology

Pain Physician 2020: 23:E429-E439

Pain is a complex and subjective experience, which varies between individuals based on a myriad of biologic, genetic, psychological, and social factors. Physiologically, pain serves an essential function to alert the body to illness or injury; however, once tissue has healed and its warning function completed, a continued pain experience becomes pathologic. When this pathologic pain is present greater than half the days over a period of at least 3 to 6 months, it is then defined as chronic pain (1,2). Chronic pain represents a growing problem for the United States, globally, and in military populations. In 2016, the prevalence of chronic pain in U.S. adults was 20.4%, and high-impact chronic pain (i.e., chronic pain that often impacts activities or limits a person's life) was 8.0% (3,4). Not only does it negatively impact the quality of life of many individuals, analysis by the Institute of Medicine (IOM) showed that this burden incurs a significant economic impact as well, as the annual economic cost due to chronic pain for the United States is $560 to $635 billion (5).

The future of chronic pain is bleak. It continues to increase in incidence and prevalence across many demographics (6). First, the 2016 Global Burden of Disease Study revealed that pain and pain-related diseases are the leading cause of disability and burden of disease globally and that worldwide the burden caused by chronic pain continues to escalate (7,8). Second, it is increasing in the general U.S. population, as evinced by a study investigating chronic low back pain in North Carolina, which found that its prevalence had more than doubled across all population groups from 4% to 10% from 1992 to 2006 (9). Finally, similar trends have been observed in military populations. An analysis in 2015 revealed an increasing incidence of chronic pain diagnoses from 30.4 per 10,000 person-years in 2007 to 107.8 per 10,000 person-years in 2014 (10). There are many reasons to believe that chronic pain will continue to rise in the U.S., including the aging of the U.S. population, rising prevalence of obesity and pain-associated chronic conditions, continued progress in saving the lives of those who suffer catastrophic injuries, continued issues in postsurgical pain management, increasing public awareness of chronic pain syndromes, and expanding medical coverage (5).

A series of policy-level instructions have been instituted since 2010 to define the nation's objectives regarding chronic pain and its management. In 2010, the Affordable Care Act (ACA) instructed the Department of Health and Human Services (DHHS) to enter an agreement with the IOM to produce a report on pain in the United States to "increase the recognition of pain as a significant public health problem in the United States." One of the recommendations produced by the IOM report was an improvement on the collection and reporting of data on pain. Similarly, the 2016 National Pain Strategy reiterated the importance of enhanced surveillance data and called for more precise estimates of the burden of chronic pain (1,11). Despite these policy-based objectives, monitoring for chronic pain on a population basis remains difficult for a variety of reasons, including the lack of a clearly delineated, standardized case definition for chronic pain (12,13). We must first establish reliable surveillance data before we can subsequently determine accurate distributions of resources for chronic pain.

Chronic pain is a significant public health concern in both civilian and military populations and has gained more attention of late, partially because of the opioid epidemic. The military is rightfully concerned about chronic pain, as persons who suffer from it experience adverse impacts on work productivity, psychological health, and quality of life metrics (14,15). This inexorably impacts service members' readiness, as demonstrated by data showing that those in the Army with chronic low back pain are at 3.65 increased risk for medical discharge (16).

This study was designed to assess the prevalence of chronic pain among active component military service members utilizing 2 distinct, published case definitions. The project investigated the demographics and military characteristics of individuals receiving chronic pain diagnoses. In addition, the study compared and contrasted the populations identified through each specific case definition. Furthermore, the inclusions of the self-reported data via the Periodic Health Assessment (PHA) allowed for improved granularity regarding military chronic pain patients' pain severity and its impacts on their job performance.

Methods

The surveillance population for this cross-sectional study included all 1,296,881 active component service members from the U.S. Army, Navy, Air Force, and Marines serving at any point during the surveillance period of January 1, 2018 through December 31, 2018. This analysis utilized data available from the Defense Medical Surveillance System (DMSS). The DMSS, maintained by the Armed Forces Health Surveillance Branch (AFHSB), is a data warehouse containing comprehensive longitudinal data on service members, including medical encounter records and demographic data. Diagnoses were ascertained from the administrative records of all medical encounters of military personnel who received care in medical facilities of the Military Health System (MHS), civilian facilities in the purchased care system (i.e., in which the care was reimbursed by the MHS), or from the Theater Medical Data Store (TMDS), which documents care provided in deployed settings. Data from patients' PHA encounters were utilized as well to derive more granular data regarding their experiences of pain. The PHA is an annual preventive health screening examination administered to all active component military members covering a wide range of topics including mental health, diet, exercise, and pain. This study was conducted as a public health surveillance activity under the auspices of a duly constituted public health authority, the AFHSB of the Defense Health Agency. As such, it was exempt from institutional review board review.

The first case definition (Case Definition 1) used to identify chronic pain cases was derived from Tian et al (17) and Clark and Taubman (10). The set of ICD-10 codes used for this definition (Table 1) was previously evaluated via chart review and found to be "highly likely" to identify chronic pain patients; however, it was also considered highly specific in its identification (17). To qualify as a prevalent chronic pain case using this definition, a service member had to have one of the defining ICD-10 codes listed in any diagnostic position of an inpatient, outpatient, or theater health care encounter during the surveillance period. An individual could be counted as a prevalent case only once during the surveillance period (Fig. 1).

The second case definition (Case Definition 2) used to identify chronic pain cases was derived from an ICD-9 to ICD-10 pain condition crosswalk developed by

Table 1. *ICD-10 codes identifying chronic pain (Case Definition 1).*

ICD-10	Description
G89.0	Central pain syndrome
G89.21	Chronic pain due to trauma
G89.22	Chronic postthoracotomy pain
G89.28	Other chronic postprocedural pain
G89.29; G89.2	Other chronic pain; chronic pain, not elsewhere classified
G89.4	Chronic pain syndrome

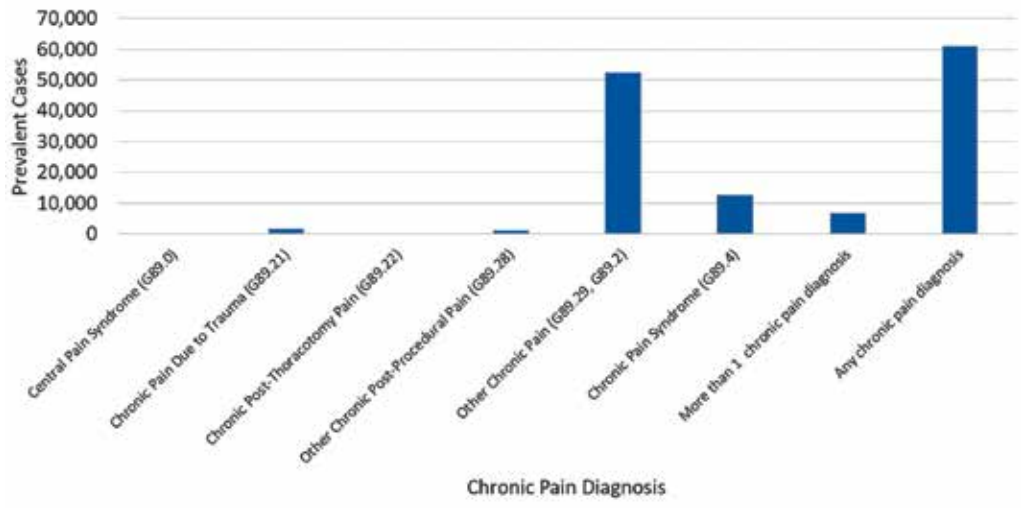

Fig. 1. *Prevalent cases by ICD-10 chronic pain diagnoses of Case Definition 1, active component U.S. Armed Forces, 2018.*

Mayhew et al (18). This crosswalk was used to identify common chronic pain conditions and provides ICD-10 diagnostic codes for 12 diagnostic clusters (Table 2) of pain conditions commonly associated with chronic pain. This case definition was developed after a review of several existing code sets, which were utilized to identify pain-related conditions that generally follow the diagnostic clusters and code sets specified by the U.S. National Pain Strategy. This strategy's purpose, among others, was to standardize and improve population research methods for pain and chronic pain, and to create a more comprehensive pain case definition. Because Case Definition 2 is a more comprehensive set of codes for identifying patients with chronic pain, our analysis instituted a rule to help distinguish chronic pain patients from those suffering from acute pain. Some clinical definitions of chronic pain require that pain be present for more than half the days over at least a 3-month period. Therefore to qualify as a chronic pain case using Case Definition 2, an individual had to be diagnosed with any of the specified ICD-10 diagnostic codes listed in Table 2 at least twice. The qualifying medical encounters had to occur more than 90 days apart. The qualifying pain diagnoses could be listed in any diagnostic position of an inpatient, outpatient, or theater health care encounter. Only one of the diagnoses was required to occur within the 2018 calendar year, thus data from medical encounters occurring from October 1, 2017 through March 31, 2019 were included for this case definition. An individual could be counted as a prevalent case only once during the surveillance period (Fig. 2).

Table 2. *ICD-10 codes by pain condition diagnostic cluster (Case Definition 2).*

1. Back pain
2. Neck pain
3. Limb/extremity pain, joint pain, and nonsystemic, noninflammatory arthritic disorders
4. Fibromyalgia
5. Headache
6. Orofacial, ear, and temporomandibular disorder pain
7. Abdominal and bowel pain
8. Urogenital, pelvic, and menstrual pain
9. Musculoskeletal chest pain
10. Neuropathy
11. Systemic disorders or diseases causing pain
12. Other painful conditions

Results

Overall, Case Definition 1 identified 60,833 cases of chronic pain in 2018 for a prevalence of 4.68%. Case Definition 2 identified 382,580 cases of chronic pain 2018 for a prevalence of 29.5%. Notably, 308,951 cases (80.8%) identified by Case Definition 2 were diagnosed with more than one diagnostic cluster, whereas only 6,652 cases (10.9%) identified by Case Definition 1 had more than one chronic pain disease code. The primary diagnostic code contributor to Case Definition 1 was "other chronic pain" (G89.2, G89.29), representing 86.2% (52,411/60,833) of chronic pain cases per this definition. Case Definition 2 was primarily comprised of musculoskeletal-related diagnostic clusters, includ-

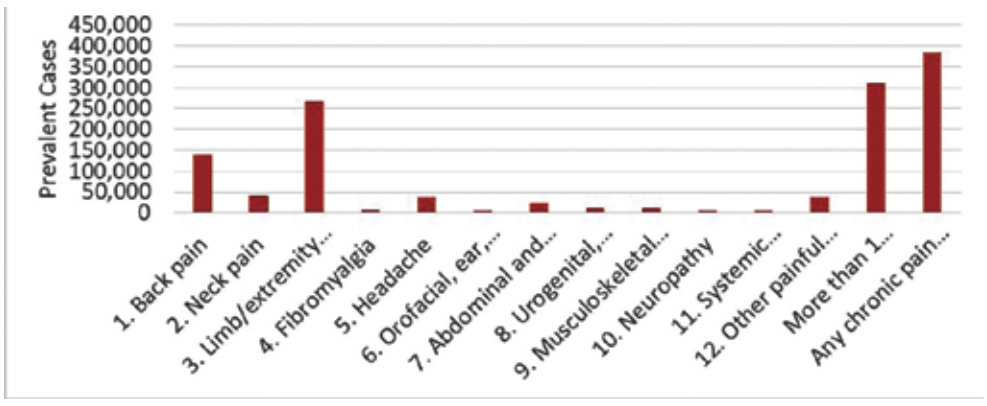

Fig. 2. *Prevalent cases by ICD-10 pain condition diagnostic cluster of Case Definition 2, active component U.S. Armed Forces, 2018.*

ing those related to limb/extremity/joint (69.3%; 265,202/382,580), back pain (36.2%; 138,436/382,580), and neck pain (10.1%; 38,785/382,580) as the top 3 contributory clusters (Table 3).

With regard to standard demographics, both case definitions 1 and 2 appeared to identify similar population distributions for gender, race/ethnicity, and age. However, it is notable that both algorithms (and particularly Case Definition 2) revealed many young patients with chronic pain conditions. In Case Definition 1, the younger than 30 year-old demographic comprised 40.8% of all chronic pain patients, and the younger than 25 year-old made up 21.3%. In Case Definition 2, the younger than 30 year-old demographic comprised 50.5% of all chronic pain patients, and the younger than 25 year-old made up 30.4%. For the younger than 30 year-old demographic in case definitions 1 and 2, these data represent 24,880 and 193,072 service members, respectively.

When we examine the prevalence of chronic pain diagnoses within each of these demographic subgroups, we find that women experience higher levels of chronic pain than men (woman CD1: 6.1%, CD2: 41.5%; men CD1: 4.4%, CD2: 27.1%). Black non-Hispanic persons showed higher levels of chronic pain than any other race/ethnicity group (Fig. 3).

It is also notable that for both women and men, as age increased, the proportion of those with a chronic pain diagnosis increased, as shown in Fig. 4.

There were some important findings from the military demographics analysis as well. First, enlisted personnel demonstrated higher prevalence of chronic pain than officers. Second, per Case Definition 1, the Army has much higher levels of chronic pain diagnoses than any other branch of service, including more than 4 times that of the Navy. Per Case Definition 2, however, the disparity is not quite as pronounced between the services (Fig. 5).

PHA questions relevant to pain revealed several differences between the 2 case definitions (Fig. 6). One question asked about the service member's self-reported average pain level over the past 24 hours based on a pain scale accompanied by descriptors of each pain level (e.g., 3 = sometimes distracts me; 6 = hard to ignore, avoid usual activities; 9 = can't bear the pain, unable to do anything, etc.). Case Definition 1 revealed 36.7% (22,301 patients) with a pain scale of 5 to 10, 32.3%

Table 3. *Characteristics of Individuals in Chronic Pain Cohorts 1 and 2, Active Component U.S. Armed Forces, 2018*

	Chronic Pain Cohort (Case Definition 1)		Chronic Pain Cohort (Case Definition 2)	
	No.	%	No.	%
Total	60,833	100.0	382,580	100.0
Gender				
Male	47,729	78.5	293,830	76.8
Female	13,104	21.5	88,750	23.2
Race/ethnicity				
White, non-Hispanic	32,604	53.6	206,145	53.9
Black, non-Hispanic	13,376	22.0	77,853	20.3
Hispanic	9,099	15.0	59,092	15.4
Other	5,754	9.5	39,490	10.3
Age				
< 20	1,185	1.9	21,767	5.7
20–24	11,818	19.4	94,488	24.7
25–29	11,877	19.5	76,817	20.1
30–34	10,266	16.9	63,074	16.5
35–39	11,727	19.3	62,838	16.4
40–44	7,968	13.1	37,091	9.7
45+	5,992	9.8	26,505	6.9

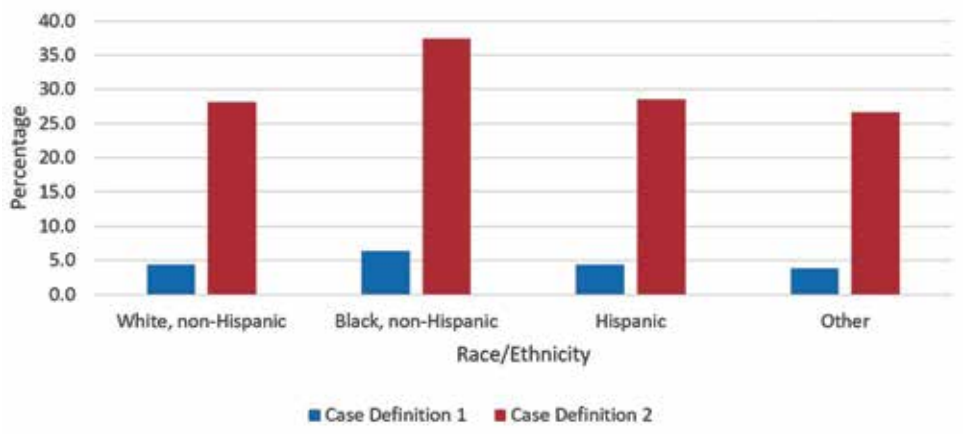

Fig. 3. *Prevalence of chronic pain by race/enthnicity per case definition, active component U.S. Armed Forces, 2018.*

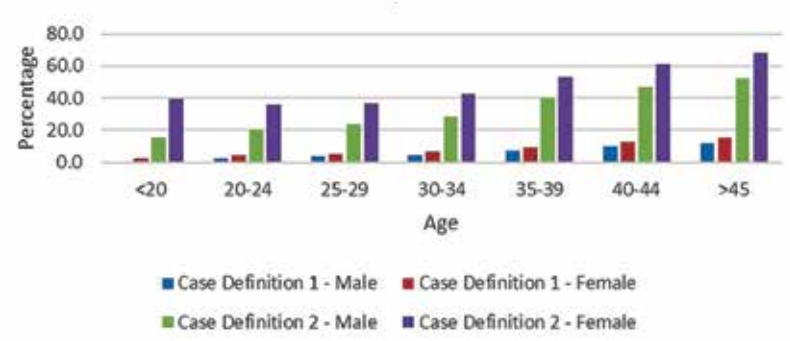

Fig. 4. *Prevalence of chronic pain by age and sex per case definition, active component U.S. Armed Forces, 2018.*

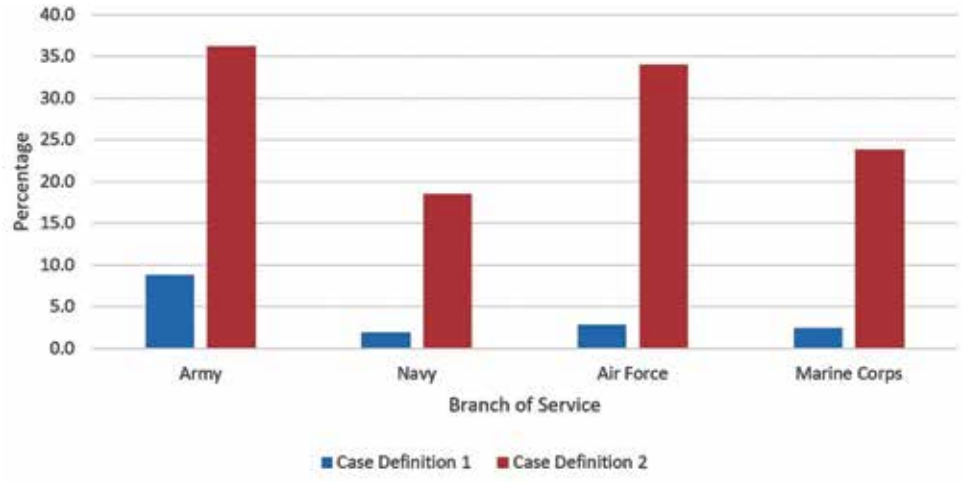

Fig. 5. *Prevalence of chronic pain by branch of service per case definition, active component U.S. Armed Forces, 2018.*

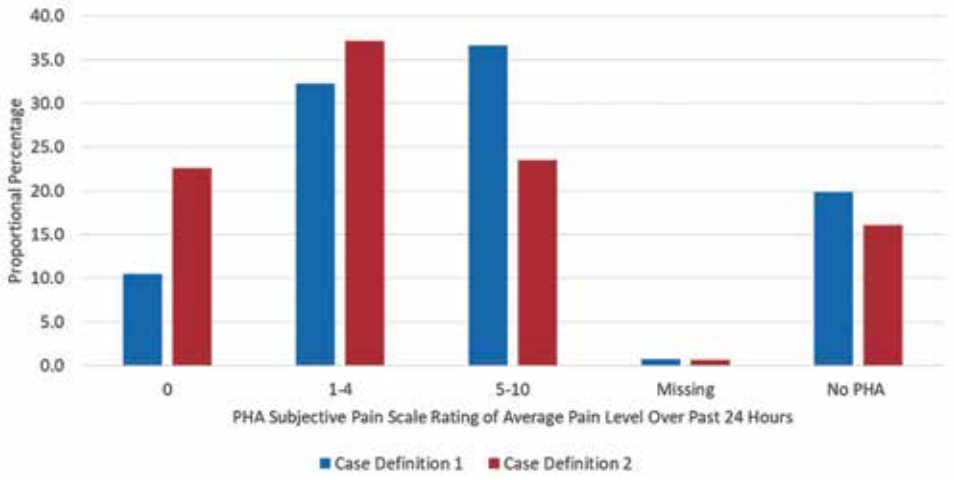

Fig. 6. *PHA pain scale proponents, Case Definition 1 vs. Case Definition 2, active component U.S. Armed Forces, 2018.*

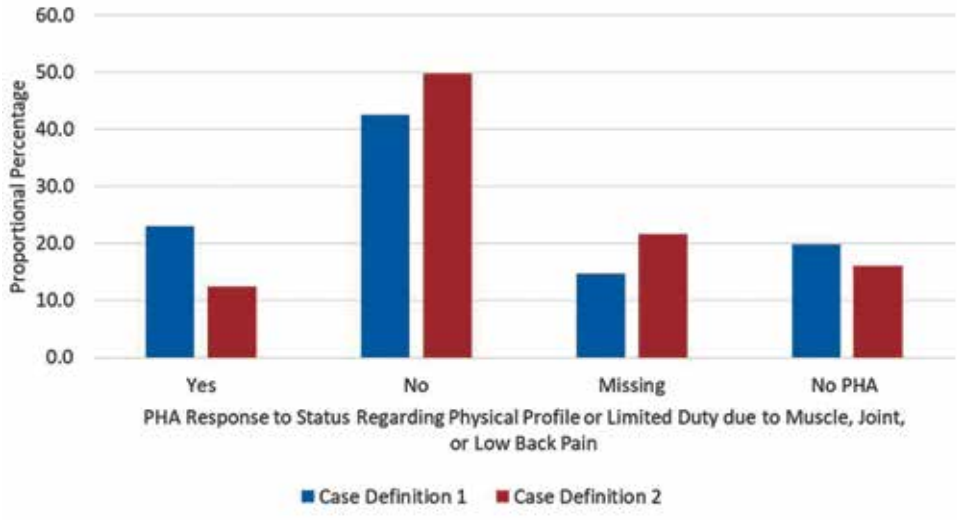

Fig. 7. *PHA status of physical profile or limited duty due to muscle, joint, or low back pain, Case Definition 1 vs. Case Definition 2, active component U.S. Armed Forces, 2018.*

(19,645 patients) with a pain scale of 1 to 4, and 10.5% (6,401 patients) with a pain scale of 0. In comparison, Case Definition 2 revealed 23.5% (89,860 patients) with a pain scale of 5 to 10, 37.1% (142,021 patients) with a pain scale of 1 to 4, and 22.6% (86,525 patients) with a pain scale of 0. Expanding on this, 43.2% of respondents in Case Definition 1 indicated that they were currently receiving treatment for pain (25.6% answered "No"), compared with 30.6% of those in Case Definition 2 (29.9% answered "No").

Another question asked if, since the patient's last PHA, they have experienced any recurring muscle, joint, or low back pain and if it impacted their duty performance (Fig. 7). Case Definition 1 revealed 36.6% (22,240 patients) answered "Yes, and now under treatment/follow-up," 12.7% (7,697 patients) answered "Yes, had medical care, but no longer under treatment/follow-up," 8.7% (5,301 patients) answered "Yes, impacted duty performance, but did not get medical care," and 21.5% answered "No." Case Definition 2 re-

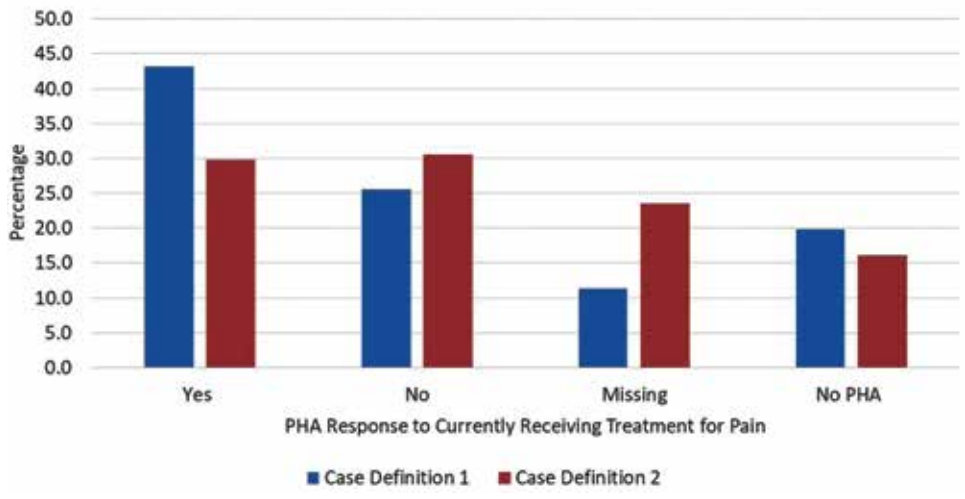

Fig. 8. *PHA currently receiving treatment for pain, Case Definition 1 vs. Case Definition 2, active component U.S. Armed Forces, 2018.*

vealed 22.7% (87,001 patients) answered "Yes, and now under treatment/follow-up," 12.6% (48,110 patients) answered "Yes, had medical care, but no longer under treatment/follow-up," 9.5% (36,277 patients) answered "Yes, impacted duty performance, but did not get medical care," and 38.7% (147,851 patients) answered "No" (Fig. 8). Following up on this musculoskeletal-based pain question, another PHA question asks if the service member is currently on any profile or limited duty for that condition. Case Definition 1 respondents answered 23.0% "Yes" (13,962 patients) and 42.5% "No" (25,856 patients), whereas Case Definition 2 respondents answered 12.5% "Yes" (47,617 patients) and 49.8% "No" (190,334 patients). Finally, regarding whether the service member is on a permanent profile, Case Definition 1 respondents answered 27.3% "Yes" (16,585 patients) and 30.7% "No" (18,649 patients), whereas Case Definition 2 respondents answered 15.0% "Yes" (57,189 patients) and 29.8% "No" (114,178 patients).

Discussion

As would be expected, Case Definition 2 identified many more prevalent cases of chronic pain than Case Definition 1. Rather than simply containing diagnostic codes explicitly mentioning chronic pain, as was the case for Case Definition 1, Case Definition 2 included codes that are less explicitly linked to chronic pain specifically and casts a wider net. It included diagnoses closely associated with chronic pain, as is discussed by its originators (18). Interestingly, the majority of patients (80.8%) in Case Definition 2 had multiple diagnostic clusters qualifying under the chronic pain diagnosis code set, whereas Case Definition 1 had a small minority (10.9%). There are several potential explanations for this. First, it is possible that patients with uncontrolled or difficult-to-manage pain conditions might seek a variety of providers from disparate specialties for appropriate management of their pain. These providers may look at pain from different perspectives and could be making different although related diagnoses, which qualify under different diagnostic clusters. Second, it is possible there are physiologic connections between several diagnostic clusters (e.g., back, neck, and extremity clusters), as the co-occurrence of pain areas is well documented. Third, there are a greater variety of diagnostic selections in Case Definition 2 versus 1, which allow for greater opportunities for multiple combinations of diagnoses.

In appraising the standard demographics data, it is concerning that a large number of relatively young members of the military experience chronic pain. When examined proportionally, there is an expected lower prevalence of chronic pain in these younger cohorts relative to older age groups. However, in terms of absolute figures, the younger than 30 year-old group represent a shockingly large number. From an operational perspective, the younger than 30 year-old demographic comprise the primary force for deployments. If these individuals suffer from chronic pain

and/or seek multiple encounters for conditions related to chronic pain, then this would constitute a blow to effective force readiness. The disparities between gender and between race/ethnicity generally align with data from civilian-based studies (19,20), yet the differences between the prevalence of chronic pain between women and men in the military are particularly pronounced. These demographic findings represent concerns worth discussing for military public health policymakers in how to best mitigate the impacts to operational readiness and to reduce disparities.

There is no clear explanation for the discrepancies between case definitions 1 and 2 with respect to branch of service. However, some contributing factors may include the Army imposing a greater institutional focus on pain management and chronic pain identification, constitutional differences in the demographics between the services, and differences in physical training methodologies. Even taking these considerations into account, it fails to fully explicate these differences in chronic pain and impactful chronic pain.

The screening questionnaires from annually collected PHAs revealed distinct differences between case definitions 1 and 2. First, it is notable that Case Definition 1 consistently found higher prevalence of impactful pain (pain levels rated as 5–10) and existence of pain when compared with Case Definition 2. This finding could indicate several possibilities, including that Case Definition 1 identifies patients with more consistent and present pain because the pain scale question asks simply about average pain experienced over the past 24 hours. It may also demonstrate that Case Definition 1 patients endure a more severe subjective pain experience, which is an idea supported by several other question indicators. Second, higher proportions of individuals in Case Definition 1 reported receiving treatment for pain and were currently under treatment for muscle, joint, or low back pain when compared with Case Definition 2. This supports the hypothesis that Case Definition 1 patients bear a more impactful pain experience in that more of them have a pain level that is to the level that they require medical management or inspires them to seek treatment. Third, Case Definition 1 patients demonstrated higher proportions of being on a permanent physical profile and on limited duty for muscle, joint, or low back pain. Service members from Case Definition 1 had a more impactful pain experience in terms of negative impacts on their ability to perform their military duties.

Strengths

This project has several strengths. First, it fulfills several goals set forth by the ACA, DHHS, 2010 National Defense Authorization Act, and the 2016 National Pain Strategy. Namely, it provides precise estimates of the burden of chronic pain to better aid in the establishment and implementation of population-based pain interventions. Second, it utilizes highly granular, standardized, and regularly collected PHA data in a novel way by assessing both patients' subjective experience of pain in addition to their medical management. The IOM Relieving Pain in America report calls for standardized question fields and protocols for electronic health records and surveys and advises that pain-related data be collected at regular intervals (5). PHA data includes exactly what the IOM report called for: standardized questionnaires collected at regular intervals about pain. This important dataset had not previously been investigated to determine the idiosyncrasies of pain in the military. Finally, this study utilizes a temporally relevant 2018 dataset, which captures nearly 100% of its population, and allows for incredibly accurate estimations of disease prevalence and burden across the entire U.S. armed forces.

Limitations

This study also had several limitations. First, in utilizing administrative data, this allows for the possibility of misclassification bias (21). It is possible that providers could make incorrect diagnoses, select incorrect codes representing diagnoses, or misclicking incorrect diagnoses within the electronic health record system. Administrative data are also troublesome if the association of the diagnostic code does not correctly or accurately represent the conditions diagnosed. Second, some TMDS deployment data still uses ICD-9 coding even in 2018. Therefore it is possible that the amount of chronic pain in the deployed setting may be underestimated by approximately 30 patients and approximately 60 encounters. Third, the prevalence estimates for the demographics were not adjusted for potential confounders. As such, this could influence some of the findings of this report. For example, the differences between junior and senior grades, as well as length of service are likely greatly influenced by age. Fourth, having greater diagnostic detail regarding pain for service members would have been valuable for drawing epidemiologic inferences. This study was therefore limited due to its use of administrative data. Finally, there were several specific diagnostic clusters that were compared

with and mixed with nondiagnostic term clusters under Case Definition 2. For example, specific diagnoses such as "neck pain" and "fibromyalgia" were both categorized in a similar fashion to "systemic disorders" and "other painful conditions." These diagnostic clusters were derived from a published case definition whose purpose was to improve population research methods for pain and chronic pain, and to create a more comprehensive pain case definition (18). However, this nonetheless could lead to difficult comparative analyses and represents a limitation inherent to Case Definition 2.

Conclusions

How we specify our case definitions when performing surveillance epidemiology can greatly influence the data we report, which subsequently influences the distribution of resources. Chronic pain has been difficult to define via administrative and screening data, and as such its burden and prevalence estimates can vary considerably depending on which case definition is used. This is of particular importance in the U.S. military, as these estimates can significantly impact our calculations for force readiness and the protection of our national security. This study investigated 2 distinct case definitions for chronic pain. Case Definition 2 identified a more comprehensive population of patients who may be experiencing chronic pain, whereas Case Definition 1 identified a more severe subset of chronic pain patients who were more likely to be on limited duty, require treatment for pain, have impactful pain, and be on a permanent physical profile. This project also found that several demographic groups were more likely to be experiencing chronic pain, including members of the Army, black non-Hispanic, women, older ages, and enlisted personnel. The methodology described in this exploratory analysis could be used as a template to better characterize the burden of chronic pain from a population-based perspective and for monitoring the effectiveness of pain management strategies. Future research is clearly indicated in this field.

References

1. Interagency Pain Research Coordinating Committee (IPRCC). *National Pain Strategy: A Comprehensive Population Health-Level Strategy by Pain*. Washington, DC: U.S. Department of Health and Human Services, National Institutes of Health 2016. Available at: https://www.iprcc.nih.gov/sites/default/files/HHSNational_Pain_Strategy_508C.pdf. Accessed 09/02/2019.
2. Treede RD, Rief W, Barke A, et al. A classification of chronic pain for ICD-11. *Pain* 2015; 156:1003-1007.
3. Dahlhamer J, Lucas J, Zelaya C, et al. Prevalence of chronic pain and high-impact chronic among adults–United States, 2016. *MMWR Morb Mortal Wkly Rep* 2018; 67:1001-1006.
4. Pitcher MH, Von Korff M, Bushnell MC, et al. Prevalence and profile of high-impact chronic pain in the United States. *J Pain* 2019; 20:146-160.
5. Institute of Medicine (IOM). *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*. Washington, DC: The National Academies Press, 2011: pp. 1-17, 55-111.
6. Van Hecke O, Torrance N, Smith B. Chronic pain epidemiology and its clinical relevance. *Br J Anaesth* 2013; 111:13-18.
7. Mills SEE, Nicolson KP, Smith BH. Chronic pain: A review of its epidemiology and associated factors in population-based studies. *Br J Anaesth* 2019; 123:e273-e284.
8. Vos T, Allen C, Arora M, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; 390:1211-1259.
9. Thorpe KE, Florence CS, Joski P. Which medical conditions account for the rise in health care spending? *Health Affairs* 2004; 23(suppl 1):W4-437-W4-445.
10. Clark LL, Taubman SB. Incidence of diagnoses using ICD-9 codes specifying chronic pain (not neoplasm related) in the primary diagnostic position, active component, U.S. armed forces, 2007-2014. *MSMR* 2015; 22:12-15.
11. Von Korff M, Scher AI, Helmick C, et al. United States National Pain Strategy for Population Research: Concepts, definitions, and pilot data. *J Pain* 2016; 17:1068-1080.
12. Maixner W, Fillingim RB, Williams DA, Smith SB, Slade GD. Overlapping chronic pain conditions: Implications for diagnosis and classification. *J Pain* 2016; 17:T93-T107.
13. Schrepf A, Phan V, Clemens JQ, Maixner W, Hanauer D, Williams DA. ICD-10 codes for the study of chronic overlapping pain conditions in administrative databases. *J Pain* 2020; 21:59-70.
14. Kawai K, Kawai AT, Wollan P, Yawn BP. Adverse impacts of chronic pain on health-related quality of life, work productivity, depression and anxiety in a community-based study. *Fam Pract* 2017; 34:656-661.
15. Reif S, Adams RS, Ritter GA, Williams TV, Larson MJ. Prevalence of pain diagnoses and burden of pain among active duty soldiers, FY2012. *Mil Med* 2018; 183:e330-e337.
16. Benedict TM, Singleton MD, Nitz AJ, Shing TL, Kardouni JR. Effect of chronic low back pain and post-traumatic stress

disorder on the risk for separation from the US Army. *Mil Med* 2019; 184:431-439.

17. Tian TY, Zlateva I, Anderson DR. Using electronic health records data to identify patients with chronic pain in a primary care setting. *J Am Med Inform Assoc* 2013; 20:e275-e280.
18. Mayhew M, DeBar LL, Deyo RA, et al. Development and assessment of a crosswalk between ICD-9-CM and ICD-10-CM to identify patients with common pain conditions. *J Pain* 2019; 20:1429-1445.
19. Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. *Br J Anaesth* 2013; 111:52-58.
20. Campbell CM, Edwards RR. Ethnic differences in pain and pain management. *Pain Manag* 2012; 2:219-230.
21. Van Walraven C, Austin P. Administrative database research has unique characteristics that can risk biased results. *J Clin Epidemiol* 2012; 65:126-131.