ORIGINAL RESEARCH

Specialty Differences in Initial Evaluation of Patients With Non-Acute Musculoskeletal Pain

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Purpose: **To explore medical diagnostic testing of new cases of musculoskeletal (MSK) conditions associated with chronic pain.**

Methods: **We analyzed nationally representative cross-sectional data of people having visits with a new likely chronic MSK pain condition. We documented depression screening and prescribing of diagnostic imaging and blood tests and explored associations between patient and provider factors for each.**

Results: **Over the 9 years of the survey, there were 11,994 initial visits for chronic MSK pain, an average of 36.8 million weighted visits per year or approximately 11.8% of the population. Proportions for depression screening, prescribed imaging, and blood tests were 1.79%, 36.34%, and 9.70%, respectively. People on any public health insurance had twice the increased relative odds to be screened for depression. Orthopedists had 3 times increased relative odds to prescribe imaging compared with family physicians; oncologists had 4 times increased relative odds to prescribe blood tests. Survey year was significantly associated with depression screening and ordering any type of imaging.**

Conclusions: **Observed rates of depression screening and nonindicated imaging for patients with chronic MSK pain have fluctuated over time. The impact of these fluctuations on clinical practice is as yet unknown. The type of nonrecommended actions varied by specialty of physician. (J Am Board Fam Med 2021;34:618–633.)**

Keywords: **Chronic Pain, Connective Tissue, Cross-Sectional Studies, Health Care Surveys, Musculoskeletal Pain, Primary Health Care**

Introduction

Chronic musculoskeletal (MSK) pain is a leading cause of global disability.[1] The prevalence of chronic MSK pain is high, affecting about one quarter of the general population worldwide, and this is expected to rise with time due to the aging of the population.[2] The annual cost of chronic pain in the United States is $560 to $635 billion a year,[3] due in part to the wide-ranging effects of chronic MSK pain on physical and psychosocial functioning,[4] thus necessitating a multimodal approach to address the complexity of chronic MSK pain.[5] To effectively address this complexity, appropriate screening and diagnostic tests are required before the implementation of a management plan.

Multiple guidelines for the management of patients with chronic noncancer pain have been written, with recommendations suggesting the use of a patient-centered, biopsychosocial approach.[6–8] A recent systematic review of "high-quality" evidence-based guidelines for a variety of MSK conditions (low back pain, shoulder pain, neck pain, or osteoarthritis) synthesized recommendations on 11 common findings across reviews.[9] Most, but not all of these reviewed guidelines included the following 4 recommendations regarding screening and assessment: (1) Clinicians should screen patients to identify those with a high likelihood of serious pathology or red

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flags. (2) Assessment of psychosocial factors. (3) Radiologic imaging is discouraged unless: (a) serious pathology is suspected, eg, cancer, central nervous system dysfunction; (b) response to conservative care is unsatisfactory or there is an unexplained progression of signs and symptoms; or (c) imaging is likely to change management; others like the Choosing Wisely campaign have highlighted how having these expensive tests will not help with symptom improvement and that they come with risks.[10] (4) Assessment should include physical examination (eg, neurological screening, mobility, and/or muscle strength tests).

Imaging and laboratory tests are typically used strategies to screen for physical or physiologic contributors to pain. In the United States, the costs of imaging are higher than those of laboratory tests, and incidental findings on imaging can lead to follow-up tests. Rates of magnetic resonance imaging (MRI), computed tomography (CT) scans, and sonography for MSK disorders have increased by 500% in the past 2 decades.[11] There are also nonfinancial costs to the patient, such as exposure to radiation and the risk of future malignancy. Thus, the potential for the downstream impact on health care costs is compounded.

Screening for depression is often assessed as an indicator of mental health conditions, with the prevalence of depression being approximately 9% in the United States among adults.[12] However, current evidence suggests that depression is screened in only about 1.4% of ambulatory office visits made by adults in the United States, with the authors concluding that the level of screening is low.[13] The association between depression and chronic pain is well known,[13,14] with 4.4% of all adults reporting both depression and chronic pain, but about one quarter of pain patients reporting depression.[15] However, the rate of depression screening in those with pain is not known. The importance of assessing the intricate relationship between depression and chronic pain in a clinical setting is of particular concern since the combination of major depression and disabling chronic pain is more costly, compared with other combinations of those with and without depression and with and without chronic pain.[16] Comorbid depression increases pain, disability, and mortality; decreases quality of life[15]; and is highest in those with chronic pain.[17] Screening for depression in people with chronic pain is useful, as depression can influence nervous system regulation of nociceptive signals,[18] is a strong indicator of treatment decisions in this population,[19] and is also a risk factor for opioid dependence, a significant ongoing problem facing US health care.[20] Further, comorbid depression in people with chronic MSK pain can drive higher levels of pain and lower levels of function,[15] resulting in greater health care use and costs.[21,22]

Since nonadherence to current guidelines[9] on the management of chronic pain might have economic repercussions on the health care system, it is crucial to document practice trends regarding the use of screening and diagnostic tests in this population. This documentation will inform the degree to which current recommendations are being followed and identify the need for further educational opportunities. To the best of our knowledge, there are no nationally representative data on the degree to which US physicians follow these guideline recommendations. To help fill this gap, the purpose of the current study of a nationally representative sample of physicians is to explore use of medical diagnostic tests and screening of new cases of MSK conditions often associated with chronic pain. Specific objectives were (1) to determine the frequency with which screening and diagnostic tests are prescribed at the initial medical encounter for patients with MSK pain that is likely chronic, and (2) to examine the association between clinician-related and patient-related factors associated with prescribing these tests.

Methods

The National Ambulatory Care Medical Survey (NAMCS) sample is drawn from the master files of the American Medical Association and the American Osteopathic Association. NAMCS uses a multistage sampling procedure to randomly select office-based physicians principally engaged in patient care activities but does not include federal employees. Physicians in the specialties of anesthesiology, pathology, and radiology are excluded from the physician universe. Not included in NAMCS were patient-physician telephone calls, house calls, visits made in hospital or emergency department settings (unless the physician has a private office in a hospital and that office meets the NAMCS definition of "office"), visits made in institutional settings (eg, nursing homes), and visits to doctors' offices that are made for administrative purposes only (eg, to leave a specimen, pay a bill, or pick up insurance forms).

Data from NAMCS have been validated against outside data sources[23,24] and using a split panel design.[25] NAMCS has been used to assess adherence to numerous diagnostic and/or treatment guidelines.[26–28]

Publicly available online documents provide further details on the NAMCS probability sampling and weighting methods.[29–32] The National Institutes of Health Office of Human Subjects Research Protection authorized an exemption from Institutional Review Board review for this study because it used publicly available and deidentified data from the NAMCS.

The final stage of NAMCS is the selection of patient visits within the annual practices of sample physicians. This involves several steps. First, in January of each year, randomized physicians are randomly assigned to 1 of the 52 weeks in the survey year (sample week). Physicians are asked to supply the number of estimated visits for the sample week, and the number of days she or he expects to see patients that week. Using this information, a randomly chosen "start" date and a predetermined sampling interval are assigned well in advance of the randomly chosen sample week. At the start of the sample week, participating physicians or their staff are instructed to keep a daily listing of all patient visits during the assigned week. This list is used as the sampling frame for patient visits to the selected physician. Visits are selected from this sampling frame using the previously determined randomly chosen "start" data and sampling interval until up to 30 visits are identified. Before 2012, this process was completed on-site by US Census Bureau staff using a simple and fast table approach (see pp. 16 to 17 in NCHS, 2011:National Center for Health Statistics. *National Ambulatory Medical Care Survey 2011 Panel Questionnaire (Form NAMCS-1).* Hyattsville, MD: National Center for Health Statistics; 2011).[33] In 2012, this table and sampling process was automated by being programmed into the computerized NAMCS survey instrument.

To collect data from each of these randomly chosen visits, patient medical records were abstracted. Since the inception of NAMCS, the patient medical record abstraction form has gone through several iterations to increase compliance and specificity.[25,34] Data collection was initially done using an article patient record form primarily incorporating check boxes but also text entries for "reasons for the visit," diagnoses, and prescribed medications and immunizations. Data abstraction was switched to a computerized system beginning in 2012. Before 2012, abstracting was done by both office staff and highly trained Census Bureau staff; between 2007 and 2011, Census staff were responsible for 55% to 60% of all abstractions. With the computerization of the data collection process, almost all abstraction (>98%) was done by Census staff. Abstraction included information on the patients' date of birth, race/ethnicity, and sex; sources of payment; injury or poisoning; reasons for visit; continuity of care; medical diagnosis made (primary, secondary, and tertiary); vital signs; medications and immunizations prescribed; diagnostic tests ordered; health education, nonmedical treatments; type of provider; visit disposition/follow-up plan; and various other kinds of information about the practice site, such as the use of electronic medical records (EMRs). Given all data were abstracted from patient charts for a given visit, no data were available on socioeconomic variables (eg, patient educational attainment, income, or occupational status), family structure (marital status, children), major life events (births, deaths, divorces), or health behaviors (exercise levels, dietary habits, type and level of alcohol consumption, type and level of tobacco use).

In addition to the completeness checks made by the field staff, clerical edits were performed on receipt of the data for central processing at the National Center for Health Statistics (NCHS). Detailed editing instructions were used to manually review the patient records and to reclassify or recode ambiguous entries. Computer edits for code ranges and inconsistencies were also performed. In addition, a randomly selected 10% sample of records was independently recoded and compared. Differences were adjudicated by a quality control supervisor. In 2015, coding error rates for the 10% sample were 1.4%.

Some missing data items were imputed by randomly assigning a value from a patient record form with similar physician and patient characteristics. For example, in 2015 the following variables were imputed: birth year (<0.1%), sex (0.6%), have you or anyone in your practice seen patient before? (1.3%), how many past visits in past 12 months (11.2% of visits by established patients), race (25.8%), ethnicity (25.8%), and time spent with physician (30.9% where a physician was seen). Blank or otherwise missing responses are so noted

in the data set for potential use as dummy variables in the analyses.

For the present study, the sample for analysis was all patient visits during the randomly chosen week where the randomized physician made a "new" diagnosis of MSK pain.

Defining the Initial Medical Encounter

As part of the abstraction process, information is captured for the "major reason for this [current] visit." One choice under "major reason" was a "new problem" (< 3 months onset), which is defined by NCHS as "a condition, illness or injury with a relatively sudden or recent onset, that is, within 3 months of this visit." We used this designation to identify the first medical encounter between this physician and this patient for each identified MSK problem as well as this physician's initial treatment plan for the MSK problem.

Defining MSK Pain

We defined visits with MSK pain using the physician's recorded diagnosis and applied an algorithm of the International Classification of Diseases, Ninth Revision (ICD-9) codes based on 3 of the 7 categories of chronic pain defined by the ICD-11 classification, notably conditions associated with chronic primary pain, neuropathic pain, and chronic MSK pain (Appendix 1).[35] Note that this coding scheme was developed by a task force established by the International Association for the Study of Pain (IASP) in collaboration with the World Health Organization (WHO) and was accepted and codified by WHO in May 2019.[36] The coding scheme system was designed by IASP/WHO to be applicable in both primary care and in specialized pain[24] management settings. (Note that while the use of ICD-10 codes had superseded the use of ICD-9 codes for billing purposes as of October 1, 2015, NCHS did not change the NAMCS coding system until January 1, 2016. Therefore, all data for these analyses were based on ICD-9 codes.)

Diagnostic and Screening Tests Conducted at Initial Medical Encounter

The NAMCS patient visit abstract form captures a variety of screening and treatment options. For the present analyses, we considered various screening and diagnostic tests that a physician may choose to order. These include depression screening, complete blood count (CBC) and CT scan, MRI, ultrasound, radiography, and ordering of 1 or more of CT scan, MRI, ultrasound, and radiography (variable name: any imaging). Note that while data on the use of several other types of blood tests were captured (electrolytes, glucose, hemoglobin A1C, prostate-specific antigen, lipids/cholesterol), there is no literature of which we are aware that related these factors to chronic MSK pain, so they were not included in the current analyses.

Patient and Practice Characteristics

The NAMCS public use files provides only limited information on patient and practice characteristics. Patient characteristics assessed in the present analyses include age (<15 years of age, 15 to 24 [reference group], 25 to 44, 45 to 65, 65 to 74, 75 or more years old), sex (male [reference], female), race/ethnicity (Non-Hispanic White [reference group], non-Hispanic Black, Hispanic, non-Hispanic other), smoking status (no current tobacco use [reference group], current tobacco use, and unknown tobacco use), source of payment (self-paid, insured, private insurance [reference group], Medicare, Medicaid, worker's compensation, and other), number of past medical visits within 12 months for other than the index visit of MSK pain (new patient at the clinic or for a patient known to that clinic: 0, 1, 2 to 3, ≥4 past visits). Practice characteristics were limited to physician specialty (family practice [reference group], internal medicine, pediatrics, general surgery, orthopedic surgery, psychiatry, neurology, oncology, other), clinical degree (MD [reference group], DO), practice type (solo [reference group] and nonsolo or group practice), office setting (private solo or private group [reference group] and all other), and use of EMRs (only EMR, part EMR and part article, all article [reference group]). We also considered visits where the patient was seen only by nonphysician health care providers working for the randomized physician (eg, physician assistants, nurse practitioners, registered nurses, other) but the n was too small (142; 1.1% of visits for "new problem" MSK condition) for reliable subgroup analyses. Information on the physician's demographic characteristics is not available in the NAMCS public use files.

Statistical Analyses

Multivariable logistic regression models that accounted for NAMCS complex survey design were used to assess relationships between diagnostic and

screening tests for MSK problems at the initial medical encounter as described above (dependent variables), with previously defined (above) patient and provider characteristics (independent variables). Odds ratios (ORs) and 95% CIs were calculated. For the logistic regression models, there was no evidence of collinearity in inspections of tolerance values, condition indices, and variance inflation factors, suggesting properly specified heteroskedastic models. Lastly, we conducted a sensitivity analysis to assess for differences in the included 3 chronic pain categories found in the NAMCS database, chronic primary pain, chronic neuropathic pain, and chronic MSK pain.

The NAMCS is a stratified multistage complex design survey. To account for such a complex survey design, all estimates presented in the text and tables were weighted to reflect national estimates (weighted frequencies and weighted percentages), and the standard errors used in computing test statistics were calculated using SUDAAN software (version 10.0, Research Triangle Institute, Inc., Research Triangle Park, NC).

Results

There were 11,994 initial medical encounters (all new problem visits) over the 9-year period with a diagnosis of likely chronic MSK pain in the NAMCS database, translating into 330.8 million weighted visits (an average of 36.8 million visits per year). Patient mean age was 52.32 (95% CI 51.7, 53.0) and average number of visits per year for reasons other than likely chronic MSK pain was 3.9 (95% CI 3.7, 4.0). Table 1 contains descriptive statistics of the sample. Most patients were female (60%), White (71%), and had private insurance (56%). The majority of physicians were family doctors, orthopedists, and internists, and most physicians worked in private group practices.

The frequency of various screening and diagnostic tests conducted or ordered by the randomly chosen physician at the first visit of a given patient diagnosed with likely chronic MSK pain were as follows: depression screening 1.79%, any imaging 36.34% (CT scan 1.54%, MRI 8.72%, ultrasound 2.13%, and radiographs 27.81%) and CBC 9.7%.

To address our second objective, we explored factors associated with the various screening and diagnostic tests. We constructed 3 multivariable models exploring factors associated with screening and diagnostic tests, specifically for depression screening, imaging (CT scan, MRI, ultrasound, radiograph), and blood testing.

Depression

Table 2 reports results for depression screening at the initial medical encounter for likely chronic MSK pain. Compared with all non-Hispanic White patients, all other races had 2 to 3 times the relative odds of being screened for depression. Considering payment source, those on Medicare had twice the relative odds of being screened for depression compared with those with private insurance. Regarding the physician specialty seen at the initial medical encounter for likely chronic MSK pain, orthopedic surgeons and all others had 86% and 73%, respectively, reduced relative odds of screening for depression compared with family physicians, while osteopathic doctors had 58% decreased relative odds compared with medical doctors. Survey year was significantly associated with depression screening (P value = .020).

Imaging

In terms of imaging, visits by females had 16% increased relative odds than visits by males to have imaging ordered, and new patients or those with 0 previous visits had 1.6 times increased relative odds compared with those with 1 previous visit. Orthopedic surgeons had nearly 3 times increased relative odds to order imaging at the initial encounter for likely chronic MSK pain compared with family physicians, as were doctors practicing in group practices (as opposed to solo practitioners). Finally, survey year was significantly associated with a physician ordering any type of imaging (P value $<$. 001).

CBC Tests

Results for the ordering of CBC tests at initial chronic MSK visits are shown in Table 2. Compared with patients under 25 years of age, patients in older age groups had 2 to 3 times the relative odds of having a CBC test ordered. Hispanic patients had 1.5 times the relative odds of having a blood test ordered compared with non-Hispanic White patients. Those receiving workers' compensation had reduced relative odds of having a CBC test ordered compared with those with private insurance. Compared with family physicians, neurologists and orthopedic surgeons had reduced

relative odds of ordering CBC tests at the initial encounter for chronic MSK pain; however, oncologists had 3.5 times the relative odds of ordering CBC tests. Survey year was not significantly associated with a physician ordering CBC tests.

Sensitivity Analysis

A model that included chronic primary pain, chronic neuropathic pain, and chronic MSK pain indicated that those with chronic primary pain had almost 3 times the relative odds to be screened for depression but had 36% decreased relative odds of being sent for imaging. Those with chronic neuropathic pain had 94% decreased relative odds to be screened for depression. Finally, people with chronic MSK pain had 200% increased relative odds of being sent for imaging and 65% reduced relative odds to have blood tests ordered (see Table 3).

Discussion

We have summarized the frequency and national estimates of screening tests ordered/performed at visits for likely chronic MSK pain in the United States from 2007 to 2015. The frequencies of depression screening and CBC tests were very low (both less than 10% of visits), while imaging was comparatively higher at more than a third of visits. Survey year was significantly associated with both depression screening and imaging, with an overall increase seen in depression screening and an overall decrease in imaging ordered. This may reflect increased knowledge of the co-occurrence of depression in this population and messaging around the prescribing of imaging.[15,37] While these changes are promising, we are unable to determine if these changes in prevalence are appropriate or inappropriate.

While the prevalence of depression screening in those with likely chronic MSK pain was low across physician specialties, the overall prevalence (1.79%) was similar to that reported for screening in the general ambulatory care population (1.40%).[13] While it is unknown how many people with a chronic MSK condition require screening, a nationally representative study of US adults found that about one quarter of individuals reporting pain also report depression.[15] Appropriateness of screening is important to determine to avoid overmedicalization. However, the finding that orthopedic surgeons and osteopathic physicians have, respectively, 86% and 58% reduced relative odds of screening for depression is notable, as these specialties are known to focus on MSK disorders. Multiple factors might explain the level of screening in these 2 specialties, including that depression had previously been assessed by another physician or at another visit as indicated in the patient's records, differences in physician scope of practice, or inadequate training or knowledge in the biopsychosocial model of pain management. We noted increased screening in all races compared with non-Hispanic Whites. The differences seen among race are likely not due to differences in care-seeking for chronic MSK, as rates have been shown to be similar across races.[38] We also found that those on Medicare were more likely to be screened than those with private insurance. This finding could be driven by the fact those with low incomes are more likely to report depression with or without pain.[15]

We found that women and new patients or established patients without any visits in the last year have increased relative odds to be sent for imaging. Being less familiar with patients and the course of their medical issues could serve as a reason that may influence the ordering of imaging. The increased relative odds among women conflicts with other studies showing that women's pain complaints are taken less seriously[39,40] but is in line with previous research showing women receive more medical care.[40,41] Orthopedic surgeons had 3 times increased relative odds of ordering any imaging compared with family physicians, which is inconsistent with studies of MRI use. Specifically, orthopedic surgeons and primary care physicians made equivalent use of MRI; however, imaging ordered by orthopedic surgeons led to higher rates of surgical interventions.[42] It is unknown whether this relationship between imaging and surgical invasiveness applies to other specialties compared with family physicians. However, the fact remains that nonessential imaging continues at a high rate.[43,44] Recent evidence reporting on nonindicated imaging use for low back pain found that family physicians are greatly influenced by the pressure applied by patients to have imaging and by the physician's inability to manage the consult without imaging.[45] Clearly, the reasons underlying the ordering of imaging are complex. Our analyses found a significant downward trend in imaging over the years

Table 1. Description of the Sample for Initial Medical Encounter for Chronic Musculoskeletal Pain

Characteristic		Weighted Frequency	Proportion
Patient characteristics	Age category:		
	<24	32423,449	9.8
	25 to 44	73083,718	22.1
	45 to 64	130756,571	39.5
	65 to 74	50940,316	15.4
	≥75	43619,913	13.2
	Female	197197,657	59.6
	Male	133626,408	40.4
	Race/ethnicity:		
	White	235032,758	71.0
	Black	34957,028	10.6
	Hispanic	41253,280	12.5
	Other	19580,999	5.9
	Smoking:		
	Not currently	202897,165	82.3
	Currently	43635,223	17.7
	Payment source:		
	Self-pay	11658,639	3.7
	Private insurance	178058,216	56.0
	Medicare	84959,930	26.7
	Medicaid/CHIP	26321,488	8.3
	Workers' comp	9294,455	2.9
	Other*	7291,229	2.3
Physician and practice characteristics	Specialty:		
	Family physician	118232,869	35.7
	Pediatrician	11321,066	3.4
	Internal medicine	68549,867	20.7
	Orthopedist	73700,336	22.3
	Neurologist	5785,281	1.8
	Other	53234,646	16.1
	Physician degree:		
	MD	296458,726	89.6
	DO	34365,339	10.4
	Type of practice:		
	Solo	104086,387	31.5
	Nonsolo (group)	226710,085	68.5
	Office type:		
	Private practice	296241,089	89.6
	All other†	34582,976	10.4
	EMR:		
	Yes, all	195712,417	59.3
	Yes, part	38619,680	11.7
	No	95852,845	29.0
Survey year	2007	33040,563	10.0
	2008	31277,438	9.4
	2009	33262,636	10.0
	2010	37958,504	11.5
	2011	33019,687	10.0

Continued

Table 1. Continued

Characteristic		Weighted Frequency	Proportion
	2012	35868,624	10.8
	2013	35906,759	10.8
	2014	38721,711	11.7
	2015	51768,143	15.6

*Source of payment other: charity, unknown, other.
†Office type—all other: office setting all other; free-standing clinics/urgicenter; federally qualified health center; mental health center; non–federal government clinic; family planning clinic; health maintenance organization or other prepaid practice; faculty practice plan.
CHIP, Children's Health Insurance Program; EMR, electronic medical record.

examined. Future studies will be required to examine the consistency of this trend.

CBC testing as part of a comprehensive examination for chronic pain is used in combination with other results to rule out possible infection, inflammation, autoimmune disorders, or cancer.[46] No specific blood test exists for detecting common MSK disorders, eg, low back pain, so it is therefore not surprising to see lower usage except for oncology where "MSK-like" pain can often manifest in the presence of bony metastases highly associated with breast, lung, and prostate cancer.[47] CBCs are ancillary tests that are routinely used to help detect conditions such as rheumatoid arthritis and the family of autoimmune rheumatic disorders. These latter populations are typically seen by rheumatologists, a specialty who were not categorized separately in the NAMCS public use files, and this may have ultimately impacted the accuracy of the prevalence of CBC tests across physician specialties. We also saw that Hispanics were 1.5 times more likely to have CBC tests ordered. This may be due to the fact that Hispanics are more likely than Whites to have more severe rheumatoid arthritis.[48] In addition, people with workers' compensation claims had relative reduced odds of having CBC tests ordered. This may be due to the fact that many work accidents are traumatic or due to repetitive strain and are either unnecessary or, as previously stated, unhelpful for diagnosis.

Our sensitivity analysis to assess for differences in categories of chronic pain, namely chronic primary pain, chronic neuropathic pain, and chronic MSK pain, indicated that there is variation in use of the diagnostic or screening tests depending on the category. Some of these results seem logical based on the diagnostic codes included in each respective category. For example, increased odds for those with chronic primary pain to have depression screening, which includes pain associated with psychosocial dysfunction and fibromyalgia, where evidence reports that 25% suffer from major depressive disorder.[49] This in combination with a known absence of structural findings in those having pain associated with psychosocial dysfunction or fibromyalgia may also explain the decreased odds of being sent for imaging. In contrast, the ICD codes informing chronic neuropathic pain infer a structural link to neural tissues. However, there is evidence of the bidirectional relationship of these syndromes and depressive symptoms.[50] Our results indicative of low screening rates for depression suggest that the relationship between neuropathic pain and depression may be underrecognized by some physicians. Finally, those with chronic MSK pain, defined by codes focusing on joint-related syndromes, had higher odds of having imaging but were less likely to have blood work. These findings are consistent with higher relative odds seen for orthopedic surgeons, who would be likely to be treating this subgroup.

Like any observational study, the present report is susceptible to both selection bias and nonresponse bias. NCHS has taken several substantial steps to reduce the occurrence and/or impact of these potential biases. First, and most important, the data collected for NAMCS are drawn from a large nationally representative random sample of ambulatory medical care visits to office-based physicians. Periodic analyses of responding and nonresponding physician characteristics have allowed NCHS to develop, test, and use statistical adjustments that effectively eliminate the impact of

Table 2. Factors Associated With Depression Screening, Any Imaging Tests, and Complete Blood Count Tests at Initial Medical Encounter

	Depression Screening OR (95% CI)	Any Imaging OR (95% CI)	CBC OR (95% CI)
Patient age (years):			
≤24	Reference	Reference	Reference
25 to 44	2.05 (0.37, 11.33)	0.85 (0.68, 1.05)	2.01 (1.21, 3.35)
45 to 64	2.04 (0.36, 11.47)	0.98 (0.80, 1.20)	2.86 (1.70, 4.80)
≥65	2.19 (0.37, 12.95)	1.06 (0.84, 1.33)	2.95 (1.75, 4.98)
Patient sex:			
Male	Reference	Reference	Reference
Female	1.12 (0.69, 1.83)	1.16 (1.01, 1.33)	1.27 (0.98, 1.64)
Race/ethnicity:			
Non-Hispanic White	Reference	Reference	Reference
Non-Hispanic Black	2.42 (1.03, 5.69)	0.90 (0.72, 1.12)	1.12 (0.78, 1.61)
Hispanic	2.79 (1.24, 6.25)	0.84 (0.67, 1.06)	1.47 (1.00, 2.17)
Non-Hispanic other	2.96 (1.06, 8.25)	1.30 (0.94, 1.81)	0.53 (0.27, 1.04)
Smoking status:			
No tobacco use	Reference	Reference	Reference
Current tobacco use	1.93 (0.82, 4.56)	0.93 (0.78, 1.11)	1.14 (0.83, 1.56)
Source of payment:			
Self-pay	0.69 (0.21, 2.27)	0.68 (0.41, 1.14)	0.71 (0.34, 1.49)
Private insurance	Reference	Reference	Reference
Any public health insurance	2.26 (1.20, 4.28)	1.03 (0.88, 1.20)	1.14 (0.86, 1.50)
Workers' comp	1.16 (0.22, 6.09)	1.06 (0.74, 1.51)	0.24 (0.08, 0.78)
Other*	2.74 (0.88, 8.52)	0.95 (0.62, 1.46)	1.09 (0.55, 2.15)
No. of past visits†			
New patient	0.94 (0.45, 1.99)	1.67 (1.35, 2.06)	1.47 (1.00, 2.16)
0 previous visits	0.82 (0.27, 2.54)	1.63 (1.26, 2.13)	0.89 (0.55, 1.45)
1 previous visit	Reference	Reference	Reference
2 to 3 previous visits	1.09 (0.51, 2.36)	0.93 (0.77, 1.12)	0.81 (0.58, 1.13)
≥4 previous visits	1.27 (0.64, 2.48)	0.83 (0.68, 1.02)	0.72 (0.50, 1.03)
Physician specialty:			
Family practice	Reference	Reference	Reference
Internal medicine	0.92 (0.50, 1.70)	1.08 (0.89, 1.32)	1.34 (0.98, 1.84)
Pediatrics	1.17 (0.10, 13.11)	1.23 (0.85, 1.79)	1.67 (0.84, 3.33)
Orthopedic surgery	0.14 (0.04, 0.44)	2.77 (2.25, 3.42)	0.07 (0.04, 0.13)
Neurology	0.66 (0.16, 2.68)	0.81 (0.59, 1.13)	0.31 (0.17, 0.57)
Oncology	1.91 (0.19, 19.08)	1.97 (0.66, 5.86)	4.00 (1.34, 11.93)
Others	0.26 (0.09, 0.73)	0.94 (0.75, 1.19)	0.69 (0.42, 1.13)
Degree:			
MD	Reference	Reference	Reference
DO	0.41 (0.19, 0.88)	0.84 (0.70, 1.02)	0.85 (0.63, 1.14)
Practice type:			
Solo	Reference	Reference	Reference
Nonsolo/group	1.54 (0.85, 2.78)	1.27 (1.08, 1.48)	0.97 (0.72, 1.30)
EMR:			
All electronic	1.89 (0.66, 5.45)	1.06 (0.87, 1.28)	0.83 (0.63, 1.10)
Part electronic/paper	1.00 (0.30, 3.35)	0.90 (0.71, 1.14)	1.02 (0.69, 1.49)
No electronic	Reference	Reference	Reference

Continued

Table 2. Continued

	Depression Screening OR (95% CI)	Any Imaging OR (95% CI)	CBC OR (95% CI)
Survey year:			
2007	Reference	Reference	Reference
2008	0.39 (0.07, 2.04)	1.08 (0.77, 1.52)	1.18 (0.73, 1.90)
2009	0.23 (0.04, 1.36)	0.89 (0.66, 1.20)	0.84 (0.50, 1.39)
2010	0.41 (0.08, 2.12)	0.92 (0.63, 1.34)	1.01 (0.64, 1.61)
2011	0.34 (0.10, 1.16)	1.07 (0.78, 1.46)	1.68 (1.07, 2.63)
2012	0.55 (0.17, 1.79)	0.68 (0.51, 0.92)	0.92 (0.62, 1.37)
2013	0.51 (0.17, 1.54)	0.63 (0.46, 0.86)	1.09 (0.70, 1.70)
2014	1.08 (0.32, 3.70)	0.76 (0.56, 1.03)	1.22 (0.78, 1.94)
2015	1.51 (0.41, 5.54)	0.77 (0.54, 1.10)	1.50 (0.76, 2.95)

*Source of payment other: charity, unknown, other.
†Number of past visits: number of visits in the past 12 months to the practice for other problems (excludes index visit). New patient by definition is a new patient to that clinic and could not have any past visits while a regular patient of the clinic; 0 visits means they were an established patient but did not see the physician for any problem in the previous 12 months.
CBC, complete blood count; CI, confidence interval; EMR, electronic medical record used in the office; OR, odds ratio.

physician nonresponse. Case selection is based on explicit, documented protocols and well-described criteria, such that all visits nationally have an have an equal chance of selection. Chart abstraction uses a thoroughly tested standardized abstraction form to guide data collection. These data are collected by office staff or highly trained Census Bureau staff without regard to any specific future uses or analyses, such that the chart abstractors are essentially "blinded" to any future hypotheses that will be tested. Quality controls are in place to assess and correct deficiencies in data completeness and accuracy. Finally, missing data for key physician or visit characteristics are imputed. Of course, these measures might have minimal impact on unknown biases.

Another limitation of this analysis is that given the limitations of the NAMCS data set, we cannot definitively differentiate acute from chronic pain conditions. We attempted to limit potential miscoding by using a chronic pain ICD coding scheme developed by the IASP in collaboration with WHO. This coding scheme was predominately composed of painful health conditions that most typically last more than 3 months. This same coding scheme has previously been used in published reports of chronic pain using NAMCS data.[51,52] Nevertheless, the potential for miscoding remains and requires replication of our findings in a nationally representative data set where pain chronicity can be assessed. It is also possible that we may have missed some patients with likely chronic pain who were seen for some other diagnosis.

Besides those mentioned above, there are several other limitations to this study. The analyses are cross sectional and visit based occurring in a particular randomly chosen week in the survey year. We therefore cannot rule out that there may have been visits for the same problem in previous years as well as the possibility of visits to other physicians in the same year that were not surveyed. For example, surveyed specialists having access to imaging or depression screening ordered by nonsurveyed family physicians would underestimate the true prevalence of imaging and depression screening in the sample population. The NAMCS public file did not provide an exhaustive list of physician specialties, which may have affected estimates of some of the screening and diagnostic tests. While EMR use was not associated with any of our factors of interest, it is unknown how EMR use by physicians on a shared EMR may have impacted estimates. However, shared EMR would be more likely in group practices, which did have increased relative odds of imaging compared with solo practices. We could not account for location of imaging facilities (eg, in clinic) but location is known to influence rates of usage.[53] The data we present from NAMCS are all visit based—that is, all screening and treatments are per the visit, not per a specific health complaint. So, for instance, when we report that non-White patients were 2 to 3 times more likely to be

Table 3. Model Results for Sensitivity Analysis Including Chronic Primary Pain, Chronic Neuropathic Pain, and Chronic MSK Pain

	Depression Screening OR (95% CI)	Any Imaging OR (95% CI)	CBC OR (95% CI)
Patient age (years):			
≤24	Reference	Reference	Reference
25 to 44	1.94 (0.34, 11.07)	0.86 (0.69, 1.06)	2.04 (1.22, 3.40)
45 to 64	1.98 (0.34, 11.55)	0.99 (0.81, 1.21)	2.85 (1.69, 4.81)
65+	2.26 (0.37, 13.97)	1.06 (0.85, 1.33)	2.93 (1.73, 4.96)
Patient sex:			
Male	Reference	Reference	Reference
Female	1.13 (0.69, 1.86)	1.16 (1.01, 1.34)	1.25 (0.97, 1.61)
Patient BMI:			
<25	Reference	Reference	Reference
25 to <30	0.87 (0.42, 1.83)	1.04 (0.81, 1.34)	0.87 (0.66, 1.16)
≥30	0.59 (0.21, 1.62)	0.93 (0.77, 1.14)	0.73 (0.53, 1.01)
Race/ethnicity:			
Non-Hispanic White	Reference	Reference	Reference
Non-Hispanic Black	2.49 (1.09, 5.66)	0.91 (0.74, 1.14)	1.07 (0.77, 1.48)
Hispanic	2.83 (1.26, 6.37)	0.83 (0.66, 1.05)	1.51 (1.02, 2.25)
Non-Hispanic other	3.16 (1.12, 8.90)	1.26 (0.90, 1.75)	0.56 (0.29, 1.08)
Smoking status:			
No tobacco use	Reference	Reference	Reference
Current tobacco use	2.00 (0.86, 4.70)	0.95 (0.79, 1.13)	1.09 (0.81, 1.46)
Source of payment:			
Self-pay	0.67 (0.20, 2.19)	0.70 (0.42, 1.17)	0.70 (0.33, 1.45)
Private insurance	Reference	Reference	Reference
Medicare/Medicaid/CHIP	2.13 (1.13, 4.01)	1.05 (0.90, 1.22)	1.14 (0.86, 1.49)
Workers' comp	1.19 (0.23, 6.23)	1.03 (0.72, 1.47)	0.26 (0.08, 0.82)
Other*	2.51 (0.82, 7.64)	0.96 (0.63, 1.46)	1.13 (0.57, 2.24)
No. of past visits:†			
New patient	0.91 (0.43, 1.94)	1.67 (1.36, 2.06)	1.46 (1.00, 2.11)
0 previous visits	0.75 (0.26, 2.15)	1.63 (1.25, 2.12)	0.91 (0.56, 1.49)
1 previous visit	Reference	Reference	Reference
2 to 3 previous visits	1.03 (0.48, 2.23)	0.93 (0.77, 1.13)	0.81 (0.58, 1.13)
≥4 previous visits	1.21 (0.61, 2.37)	0.84 (0.68, 1.03)	0.72 (0.50, 1.03)
Physician specialty:			
Family practice	Reference	Reference	Reference
Internal medicine	0.92 (0.50, 1.69)	1.09 (0.90, 1.34)	1.33 (0.97, 1.82)
Pediatrics	0.14 (0.05, 0.45)	2.70 (2.19, 3.33)	0.07 (0.04, 0.14)
Orthopedic surgery	1.16 (0.10, 13.63)	1.26 (0.87, 1.82)	1.64 (0.82, 3.26)
Neurology	0.70 (0.18, 2.74)	0.83 (0.60, 1.16)	0.31 (0.16, 0.58)
Oncology	1.77 (0.18, 17.79)	2.27 (0.69, 7.48)	3.50 (1.09, 11.25)
Others	0.26 (0.09, 0.73)	0.97 (0.77, 1.23)	0.63 (0.40, 1.01)
Degree:			
MD	Reference	Reference	Reference
DO	0.41 (0.19, 0.89)	0.85 (0.70, 1.02)	0.85 (0.64, 1.14)
Practice type:			
Solo	Reference	Reference	Reference
Nonsolo/group	1.46 (0.81, 2.64)	1.27 (1.09, 1.48)	0.98 (0.74, 1.31)
EMR:			
All electronic	1.93 (0.65, 5.71)	1.05 (0.87, 1.27)	0.83 (0.63, 1.10)

Continued

Table 3. Continued

	Depression Screening OR (95% CI)	Any Imaging OR (95% CI)	CBC OR (95% CI)
Part electronic/paper	1.04 (0.31, 3.53)	0.89 (0.70, 1.14)	1.00 (0.68, 1.47)
No electronic	Reference	Reference	Reference
Chronic primary pain:			
Yes	2.68 (1.41, 5.09)	0.64 (0.43, 0.97)	0.62 (0.32, 1.20)
No	Reference	Reference	Reference
Chronic neuropathic pain:			
Yes	0.06 (0.01, 0.52)	1.23 (0.57, 2.66)	0.48 (0.17, 1.32)
No	Reference	Reference	Reference
Chronic MSK pain:			
Yes	1.28 (0.50, 3.27)	1.99 (1.26, 3.12)	0.35 (0.19, 0.64)
No	Reference	Reference	Reference
Survey year:			
2007	Reference	Reference	Reference
2008	0.41 (0.08, 2.16)	1.07 (0.77, 1.50)	1.16 (0.72, 1.88)
2009	0.24 (0.04, 1.49)	0.88 (0.66, 1.18)	0.81 (0.49, 1.34)
2010	0.42 (0.08, 2.19)	0.92 (0.63, 1.35)	0.99 (0.63, 1.56)
2011	0.35 (0.10, 1.21)	1.06 (0.78, 1.45)	1.64 (1.05, 2.56)
2012	0.56 (0.17, 1.84)	0.68 (0.50, 0.91)	0.93 (0.62, 1.38)
2013	0.52 (0.17, 1.58)	0.63 (0.46, 0.86)	1.10 (0.70, 1.71)
2014	1.07 (0.31, 3.74)	0.77 (0.57, 1.04)	1.19 (0.75, 1.90)
2015	1.53 (0.41, 5.73)	0.77 (0.54, 1.10)	1.48 (0.75, 2.91)

*Source of payment other: charity, unknown, other.
†Number of past visits: number of visits in the past 12 months to the practice for other problems (excludes index visit). New patient by definition is a new patient to that clinic and could not have any past visits, while a regular patient of the clinic who has 0 visits means they were an established patient but did not see the physician for any problem in the previous 12 months.
BMI, body mass index; CBC, complete blood count; CHIP, Children's Health Insurance Program; CI, confidence interval; EMR, electronic medical record; MSK, musculoskeletal; OR, odds ratio.

screened for depression compared with White patients, we cannot directly relate that screening specifically to the MSK diagnosis per SE. The ICD-9 coding of chronic pain may have missed some patients with chronic MSK pain who were seen for a different diagnosis. Since pain chronicity was not directly assessed, it is possible that some cases identified as chronic based on ICD-9 coding were, in fact, not chronic, that is, of less than 3 months' duration. We did not examine patient preferences and, as noted earlier, this may influence the ordering of imaging in particular.

Conclusion

Chronic MSK pain has a substantial impact on physical and mental functioning, productivity, quality of life, and social relationships. It is also the leading cause of disability globally and is often refractory to treatment.[54] Using a representative sample of ambulatory office visits by Americans, we were able to provide an overview of what screening and diagnostic tests are being ordered/performed and to whom and by whom for the initial encounter of people with likely chronic MSK pain. Going forward and in the relative absence of specific recommendations for these areas, these data will help inform future surveys of rates of physician use. Our data indicate that the psychosocial aspect of likely chronic MSK pain is being at least partially addressed by a recent increase in screening for depression, although it remains low. Knowing the rate of depression among those with chronic MSK pain would be helpful for future studies to identify. This would then indicate whether current rates are appropriate and on target. This is particularly important given the bidirectional relationship between depression and pain. Effective screening can be easily achieved with the use of short validated questionnaires to optimize management.[12] The rate of

imaging is decreasing, possibly owing to current messaging in specific populations, eg, low back pain, osteoarthritis, around the use of nonindicated imaging. While these initial estimates are promising, the rates of depression screening were extremely low, and the use of imaging remains relatively high. Future studies will need to examine if these trends continue to increase and decrease respectively in a significant manner and whether these changes are associated with changes to guidelines for noncancer pain (ie, specific recommendations for screening and diagnostic tests). In particular, research to better understand physician decision processes when considering diagnostic imaging would help improve understanding of practice trends in this area.

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Appendix 1. Diagnostic Categories, Diagnoses and Codes

Category	Diagnosis	ICD-9 CODE	Raw n
Chronic primary pain (n = 11015)	Fibromyalgia, myositis, myofascial pain, neuralgia, muscle/musculoskeletal/ neuromuscular	729.1	478
	Pain, generalized	780.96	154
	Chronic pain	338.29	319
	Chronic pain associated with psychosocial dysfunction	338.4	74
	Chronic pain due to trauma	338.21	3
Chronic neuropathic pain (162)	Peripheral neuropathic pain	355.71, 355.4	0
	Regional pain syndrome	355.9	148
	Regional pain syndrome type 1	337.20	5
	Regional pain syndrome type 1 lower limb	337.22	2
	Regional pain syndrome type 1 upper limb	337.21	4
	Regional pain syndrome type 1 specified site NEC	337.21	0
	Regional pain syndrome type 2 lower limb	355.71	1
	Regional pain syndrome type 2 upper limb	354.4	2
Chronic musculoskeletal pain (n = 11621)	Osteoarthrosis generalized multiple sites	715.09	220
	Osteoarthrosis shoulder	715.11	23
	Osteoarthrosis hand	715.14	10
	Osteoarthrosis hip	715.15	11
	Osteoarthrosis knee	715.16	16
	Osteoarthrosis ankle/foot	715.17	68
	Osteoarthrosis unspecified	715.9	3
	Other unspecified arthropathies	716	1111
	Internal derangement of kneeChondromalacia patella	717717.7	547
	Joint pain, unspecified	719.4	2938
	Spondylosis and allied disorders	721.0, 0.1,0.2,0.3,0.4	260
	Intervertebral disc disorders	722, 22.0,0.1,0.2,.4.5,0.51,0.52,0.6,0.7,0.8	683
	Other disorders of cervical region	723, 723.0,0.1,0.2,0.3,0.4,0.5	1009
	Other and unspecified disorders of back	724, 724.0,0.1,0.2,0.3,0.4,0.5,0.6,0.7	2982
	Peripheral enthesopathies and allied syndromes	726, 0.0,0.1,0.12,0.3,0.31,0.32,0.33, 0.4,0.5,0.6,0.61,0.64,0.65, 0.7,0.71,0.72,0.73	1160
	Other disorders of synovium, tendon, and bursa	727, 0.0,0.00,0.04,0.05, 0.06,0.4,0.6,0.8,0.83,0.89	691
	Disorders of muscle, ligament, fascia	728.1,0.5,0.6,0.7,0.71,0.89	221
	Other disorders of soft tissues	729.0,0.1,0.2,0.5	1373

ICD-9, International Classification of Diseases, Ninth Revision; NEC, not elsewhere classifiable.