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HEALTH SERVICES RESEARCH

A Regional Analysis of Low Back Pain Treatments in the Military Health System

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Study Design. Claims-based analysis of cohorts of TRICARE Prime beneficiaries.

Objective. To compare rates of utilization of 5 low back pain (LBP) treatments (physical therapy (PT), manual therapy, behavioral therapies, opioid, and benzodiazepine prescription) across catchment areas and assess their association with the resolution of LBP.

Summary of Background. Guidelines support focusing on nonpharmacologic management for LBP and reducing opioid use. Little is known about patterns of care for LBP across the Military Health System.

Patients and Methods. Incident LBP diagnoses were identified data using the International Classification of Diseases ninth revision before October 2015 and 10th revision after October 2015; beneficiaries with "red flag" diagnoses and those stationed overseas, eligible for Medicare, or having other health insurance were excluded. After exclusions, there were 159,027 patients remained in the final analytic cohort across 73 catchment areas. Treatment was defined by catchment-level rates of treatment to avoid confounding by indication at the individual level; the primary outcome was the resolution of LBP defined as an absence of administrative claims for LBP during a 6 to 12-month period after the index diagnosis.

Results. Adjusted rates of opioid prescribing across catchment areas ranged from 15% to 28%, physical therapy from 17% to 39%, and manual therapy from 5% to 26%. Multivariate logistic regression models showed a negative and marginally significant association between opioid prescriptions and LBP resolution (odds ratio: 0.97, 95% CI: 0.93–1.00; $P = 0.051$) but no significant association with physical therapy, manual therapy, benzodiazepine prescription, or behavioral therapies. When the analysis was restricted to the subset of only active-duty beneficiaries, there was a stronger negative association between opioid prescription and LBP resolution (odds ratio: 0.93, 95% CI: 0.89–0.97).

Conclusions. We found substantial variability across catchment areas within TRICARE for the treatment of LBP. Higher rates of opioid prescription were associated with worse outcomes.

Key words: behavioral therapy, benzodiazepines, health services, low back pain, manual therapy, military medicine, opioids, physical therapy, treatment

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Low back pain (LBP) is a common, potentially disabling, condition with an estimated point prevalence of 12% and a lifetime prevalence of 40%.[1] LBP is a particular concern for the Military Health System (MHS) and a leading cause of medical separation from service for soldiers.[2,3] From 2010 to 2014, LBP was associated with over 6 million outpatient visits and 25,000 hospitalizations among active service members[4]; much more active-duty personnel might be seen informally and triaged back to training without recorded visits within the MHS.

The MHS provides health care to active-duty and retired military personnel and their civilian dependents, either through a direct care system staffed and operated by military employees (either uniformed or civil service) or through a purchased care system of civilian health care providers.[5] Studies have documented substantial geographic variation in care within the MHS with important cost implications.[5,6] Large geographic variations in treatment rates are often associated with uncertainty regarding the best treatment, as is the case with LBP care.[7] Numerous clinical practice guidelines for the treatment of LBP, including one specifically from the Department of Veterans Affairs and Department of

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Defense, support focusing on nonpharmacologic management, promoting self-care, and reducing reliance on medication, particularly opioids.[8,9]

Little is known about the variability in patterns of care for LBP across the MHS. In this study, we use the MHS data repository (MDR) to characterize variations in care for LBP. Using these data, we evaluate variations in utilization and outcomes among adult TRICARE beneficiaries with LBP. We hypothesize that patients are treated differently across TRICARE catchment areas and that these treatment differences are associated with different rates of resolution of LBP across areas.

PATIENTS AND METHODS

Data Source and Study Population

We constructed a cohort of TRICARE Prime beneficiaries aged 19 to 64 years diagnosed with LBP between April 2015 and December 2018. Data for the analysis were extracted from the MDR, including inpatient, outpatient, and pharmacy claims for both direct care and purchased care services. TRICARE beneficiaries are assigned to a catchment area based on the zip code of their current residence. A military treatment facility (MTF) based catchment area consists of zip codes within a 40-mile radius of an MTF. Geographic (non–MTF-based) catchment areas are comprised of zip codes that do not fall within 40 miles of an MTF, aggregated at the state [or sub-state (*e.g.*, Northern California)] level. Beneficiaries stationed overseas, eligible for Medicare, or having other health insurance were excluded.

Incident LBP diagnoses were identified data using the International Classification of Diseases ninth revision (ICD-9) before October 2015 and the 10th revision (ICD-10) codes from October 2015 onwards. The onset of LBP was defined as the first claim date with an LBP inclusion diagnosis (Appendix Table A.1, Supplemental Digital Content 1, http://links.lww.com/BRS/C44), provided that the 12-month period before that date was free from a documented LBP inclusion diagnosis within the MDR. This process identified 291,950 beneficiaries with incident LBP. We also performed a sensitivity analysis on a subgroup limited to just diagnosis codes for Lumbago and Dorsalgia.

Patients with concomitant "red flag" diagnoses such as cancer and paralysis (Appendix Table A.1, Supplemental Digital Content 1, http://links.lww.com/BRS/C44) in the period from 3 months before the index date to 12 months after the index date was excluded from the analysis (83,227 patients, 28.5%). In addition, 42,482 patients (14.6%) were excluded who, within the 3-month period before their index date, previously received one or more LBP treatments (Appendix, Table A.2, Supplemental Digital Content 1, http://links.lww.com/BRS/C44), or an opioid or benzodiazepine prescription for any indication. Finally, 7461 patients (2.5%) residing in catchment areas with fewer than 500 LBP patients were excluded to minimize statistical noise in estimating catchment area treatment rates. After these exclusions, 159,027 LBP patients remained in the final analytic cohort among 35 MTF-anchored catchments and 38 geographic catchments(Appendix Table A.3, Supplemental Digital Content 1, http://links.lww.com/BRS/C44).

Treatment Measures

Current Procedural Terminology codes and National Drug Codes were used to identify treatments received during the 3-month period after the index LBP diagnosis, including physical therapy, manual therapy, behavioral therapies, opioid prescription, and benzodiazepine prescription. Because we sought to understand the influence of regional provider patterns in the propensity to use specific treatments and to avoid confounding by indication at the level of the individual, we aggregated each measure to create adjusted treatment rates at the catchment area level, with indirect adjustments for age, sex, and beneficiary status.[10] This is a type of instrumental variable analysis that compares groups of patients that differ in the likelihood of receiving a given treatment, rather than the actual treatment received; as such, it estimates treatment effects on the marginal population defined as those who would receive the treatment in areas with high but not with low treatment rates.[11]

To facilitate comparisons of odds ratios across treatment types, each adjusted treatment rate was normalized by its SD. The treatments were not mutually exclusive, so some patients had multiple treatments during the first 3 months. The overall rate of spine surgery (Appendix A.2) in the first 3 months was just 0.3%, so we did not calculate catchment-level rates for surgery, as these were statistically imprecise.

Outcome Measures

The primary outcome measure was defined as an absence of MDR claims for LBP visits or admissions during the 6 to 12-month window after the index LBP diagnosis. The secondary outcome measure focuses on the same 6 to 12-month window but establishes a higher threshold for success: the patient had neither a claim with an LBP diagnosis nor a claim with any of the following potential LBP treatments: physical therapy, manual therapy, behavioral therapies, an opioid prescription, a benzodiazepine prescription, or spine surgery.

Covariates

Baseline demographics were obtained from the TRICARE enrollment file including age category, sex, beneficiary status (active, dependent, or retired/other), and catchment area. We included "other" enrollees with retired given their similar average ages. For the purpose of risk adjustment, we included 11 specific LBP diagnoses during the index month as categorical variables (Appendix Table A.1, Supplemental Digital Content 1, http://links.lww.com/BRS/C44); an additional variable identified beneficiaries with 2 or more different LBP diagnoses, as a potential marker of complexity or severity.

Statistical Analyses

Descriptive statistics were calculated for beneficiary baseline characteristics (age, sex, beneficiary status, and index LBP diagnosis) and treatments (manual therapy, physical therapy, behavioral therapies, and opioid and benzodiazepine prescriptions). As noted, we consider catchment area rates of treatment rather than individual treatment measures as the likelihood of unobserved confounding is greater at the individual level (*e.g.*, patients with more severe LBP will be more likely to receive more treatments) than at the catchment area level, where large cohort sizes tend to average out individual heterogeneity in severity.[11] We performed subgroup analyses by beneficiary type (active duty, dependent, or retired/other).

Separate multivariate logistic regression models were estimated using the individual-level outcome measures and individual and catchment area covariates described for the overall sample and each of the 3 beneficiary types; odds ratios and 95% CI are reported. The logistic regression models group the standard errors on the catchment area to account for clustering. All models were estimated using SAS version 9.4.

RESULTS

Table 1 shows the cohort characteristics. The modal age category was 45 to 54 (29%); 34% were active-duty service members, 51% were retired, and 15% were dependents; on average, across catchment areas, 56% were male and the vast majority had nonspecific LBP (72% backache/lumbago and 15% dorsalgia); cases that included radiculopathy and/or sciatica accounted for 10% to 15% of the cases. The average resolution rate for LBP was 79%, defined as an absence of claims with an LBP diagnosis 6 to 12 months after the index date. The secondary definition of resolution (an absence of claims with LBP diagnosis or treatments 6–12 mo after the index date) showed a 61% rate of resolution. That is, nearly 20% of the identified index LBP cases continued to receive one or more of these interventions although no ongoing LBP diagnosis was documented.

Figure 1 summarizes the rates of treatments received across catchment areas; this shows the magnitude of the differences in the likelihood of receiving each treatment based on the catchment area. Physical therapy (PT), manual therapy, and opioid prescription were the most commonly received treatments in the first 3 months, with substantial variation across catchment areas. Opioid prescribing rates (adjusted for age, sex, and beneficiary category) ranged from 15% to 28%; rates of physical therapy ranged from 17% to 39%, and manual therapy from 5% to 26%. Table 2 summarizes the average rates of treatment received, both overall and by beneficiary category; there were clinically important differences across categories with rates of nonpharmacologic treatments (PT, manual therapy, and behavioral therapies) significantly higher in the active-duty cohort, and opioid and benzodiazepine prescription significantly lower in this cohort.

TABLE 1. Summary Statistics

Sample size	159,027
Age category (%)	
19–34	26.6
35–44	24.6
45–54	29.3
55–64	19.5
Beneficiary type (%)	
Dependent	14.9
Retired	51.4
Active	33.8
Sex (M)	56.2
Index diagnosis (%)	
Dx = lumbosacral spondylosis without myelopathy	3.6
Dx = displacement of thoracolumbar, lumbar, or lumbosacral intervertebral disc	2.5
Dx = degeneration of thoracolumbar, lumbar, or lumbosacral intervertebral disc	4.7
Dx = other thoracolumbar, lumbar, or lumbosacral disc disorder	0.2
Dx = lumbago/backache	72.0
Dx = sciatica	9.5
Dx = thoracic or lumbosacral neuritis or radiculitis; radiculopathy	5.2
Dx = spondylolysis, site unspecified	0.2
Dx = spondylolisthesis, site unspecified	4.3
Dx = dorsalgia	15.2
Dx = lumbar sprain/strain	2.8
Two or more qualifying index diagnoses	14.2
No LBP diagnosis 6 to 12 mo after index event (%)	78.9
No LBP diagnosis, surgery, or treatment 6 to 12 mo after index event (%)	60.5

LBP indicates low back pain.

Table 3 summarizes the main results of the multivariate logistic regression models evaluating the association of catchment area treatment rates on the resolution of LBP. The analysis of patients with no additional LBP diagnosis in the 6 to 12 months after the index event (model 1) showed a negative and marginally significant association between opioid prescriptions and successful resolution of LBP (odds ratio: 0.97, 95% CI: 0.93–1.00) but no significant impact of physical therapy (odds ratio: 0.98, 95% CI: 0.94–1.03), manual therapy (odds ratio: 1.01, 95% CI: 0.97–1.05), benzodiazepine (odds ratio: 1.01, 95% CI: 0.97–1.04), or behavioral therapies (odds ratio: 1.00, 95% CI: 0.97–1.03).

When the outcome measure required an absence of both LBP diagnosis and any ongoing treatments (model 2), the results indicated a stronger negative association between back pain resolution and opioid prescribing (odds ratio: 0.94, 95% CI: 0.92– 0.97), as well as negative associations with physical therapy (odds ratio: 0.96, 95% CI:

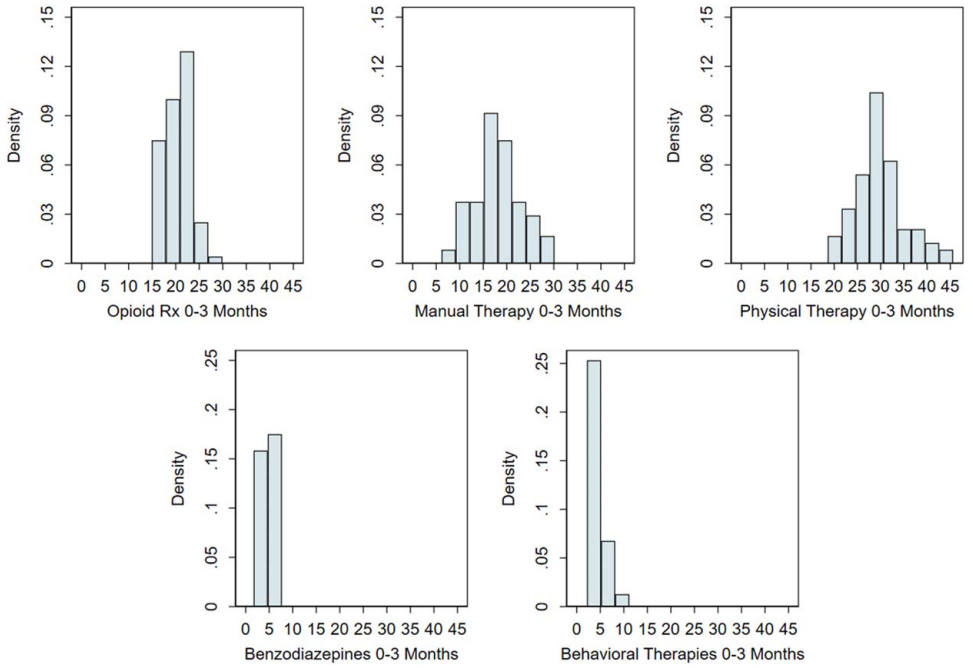

Figure 1. Histogram of rates of treatments for lower back pain, by catchment area, 2015–2019. Limited to areas with at least 500 people in the back pain cohort. Treatments are limited to the first 3 months after the index event (for those not receiving treatment before the index event).

0.92–0.99), and behavioral therapies (odds ratio: 0.94, 95% CI: 0.93–0.98). Finally, when the analysis of the primary outcome was restricted to the subset of only active-duty personnel, successful LBP resolution was again negatively associated with opioid prescriptions (odds ratio: 0.93, 95% CI: 0.89–0.97) but there were no significant

TABLE 2. Treatment Rates by Beneficiary Category

	Overall	Beneficiary type			*P* (Relative to active)	
		Dependent	Retired	Active	Dependent	Retired
Age						
Mean	43.30	35.52	51.34	34.49	<0.0001	<0.0001
SD	10.92	7.35	7.00	7.23	—	—
Physical therapy (0–3 mo); %						
Mean	27.2	23.3	19.3	40.9	<0.0001	<0.0001
SD	44.5	42.3	39.4	49.2	—	—
Manual therapy (0–3 mo); %						
Mean	16.7	16.2	12.4	23.4	<0.0001	<0.0001
SD	37.3	36.8	33.0	42.3	—	—
Opioid prescribing (0–3 mo); %						
Mean	21.3	21.7	25.2	15.1	<0.0001	<0.0001
SD	40.9	41.2	43.4	35.8	—	—
Benzodiazepines (0–3 mo); %						
Mean	5.1	5.4	5.5	4.3	<0.0001	<0.0001
SD	22.0	22.6	22.8	20.3	—	—
Behavioral therapies (0–3 mo); %						
Mean	2.0	2.5	1.0	3.5	<0.0001	<0.0001
SD	14.1	15.5	9.7	18.3	—	—
Sample size						
N	159,027	23,622	81,661	53,744	—	—

Measured at the individual level, not the catchment area. "Other" beneficiary categories are included with retirees.

TABLE 3. Logistic Regression Results Including Odds Ratios for Successful Resolution of Lower Back Pain (No Further LBP-Related Claims 6–12 mo After Index Event)

Catchment area treatment rates	Model 1		Model 2		Model 3	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Opioids	0.96	(0.92–1.00)	0.94	(0.92–0.97)	0.93	(0.89–0.97)
Physical therapy	0.98	(0.94–1.03)	0.96	(0.92–0.99)	0.95	(0.90–1.01)
Manual therapy	1.01	(0.97–1.05)	0.99	(0.96–1.02)	1.03	(0.97–1.08)
Benzodiazepine	1.01	(0.97–1.04)	1.00	(0.97–1.04)	0.98	(0.92–1.04)
Behavioral therapies	1.00	(0.97–1.03)	0.97	(0.94–0.99)	1.03	(0.99–1.07)
Outcome variable	No LBP Dx	—	No LBP Dx or treatment	—	No LBP Dx	—
Risk-adjustment covariates included?	Yes	—	Yes	—	Yes	—
Cohort	All LBP	—	All LBP	—	Active-duty only	—
Sample size	159,027	—	159,027	—	53,744	—

LBP indicates low back pain.

associations for physical therapy (odds ratio: 0.95, 95% CI: 0.90–1.01), manual therapy (odds ratio: 1.03, 95% CI: 0.97–1.08), benzodiazepine prescription(odds ratio: 0.98, 95% CI: 0.92–1.04), or behavioral therapies (odds ratio: 1.03, 95% CI, 0.99–1.07). When the analyses were repeated using just patients with ICD codes for lumbago and/or Dorsalgia, the results remained essentially unchanged.

DISCUSSION

In this claims-based analysis of TRICARE Prime beneficiaries aged 19 to 64, we found substantial variation in the treatment of LBP across MHS catchment areas. Physical therapy was the most commonly used of the assessed treatments with catchment area rates ranging from 17 to 39%. Opioid prescription was the next most commonly used treatment with rates ranging from 15% to 28% and was associated with significantly worse outcomes. Behavioral therapies were rarely used and were also associated with lower rates of LBP resolution when the definition of the resolution included ongoing treatments in addition to LBP diagnoses. Practice patterns for active-duty beneficiaries were more consistent with guideline recommendations (higher rates of nonpharmacologic interventions and lower rates of opioid and benzodiazepine prescription) but the rates of opioid prescription were still associated with worse outcomes in the model restricted to active-duty beneficiaries.

Our findings are generally consistent with prior studies looking at the treatment of LBP among soldiers. In an older study, Larson *et al*[12] evaluated the treatment of LBP among soldiers from 2012 to 2014 and found 26% receiving exercise therapy, 14% "other physical therapy," and 24% receiving opioids. They found that early opioid use was associated with a higher likelihood of negative outcomes, including military duty limitation and emergency department visits.[12] These results are also consistent with randomized control trial data by Krebs *et al* showing that for veterans with chronic LBP or hip or knee osteoarthritis pain, treatment with opioids resulted in worse pain severity at 1 year than treatment with a nonopioid strategy.[13]

Although our study did not find a significant association between LBP resolution and receipt of nonpharmacologic therapy, Larson *et al*[12] found that early nonpharmacologic treatment without opioids was associated with a lower likelihood of military duty limitation and pain-related hospitalization. The high rate of opioid prescription in our study is also consistent with findings by Schoenfeld *et al*[14] who found that among new sustained (>6 mo continuous prescription) opioid users in TRICARE from 2006 to 2014, "lumbago" was the most common indication for an initial opioid prescription at Military Medical Centers and the second most common indication behind "other ill-defined conditions" at Civilian Medical Centers.

An important aspect of our analysis involves the use of treatment rates at the catchment area level in our regression models. Because the analysis was based on claims, we do not have clinical details or patient-reported severity to completely control for potential differences between patients across areas. In this setting, instrumental variable type analyses may more effectively control for potential confounding than traditional risk adjustment methods.[11] In addition, they are better suited to policy-level questions regarding the impact of health system changes on populations rather than the effectiveness of specific treatments on individual patients.[11] Our results suggest that health system initiatives to lower the rate of opioid use for LBP in higher-use areas within the MHS should improve overall LBP outcomes.

Treatment with benzodiazepines was fairly uncommon and did not vary much across areas. As a result, it is not surprising that there was no significant relationship between benzodiazepine prescription with LBP outcomes in our analyses. However, given the lack of evidence of effectiveness in LBP,[15] suggestive evidence of worsened pain relative to placebo in a randomized trial of sciatica,[16] and a strong recommendation against their use in the Veterans Affairs/Department of Defense clinical practice guideline for the treatment of LBP, a 5% treatment rate still seems unduly high.

Behavioral therapies were uncommon but associated with a reduced chance of LBP resolution in one of our models despite evidence suggesting their effectiveness in treating LBP and being recommended in a number of LBP guidelines.[9,17] It is worth noting that behavioral therapies were only significantly associated with ongoing LBP utilization when ongoing treatments without a specific LBP diagnosis were included in the definition of ongoing utilization. Furthermore, guidelines only recommend behavioral therapies for chronic, not for acute LBP.[9,17] Thus, despite our use of a lookback period to identify new-onset cases of LBP, the use of behavioral therapies may be related to some increased chronicity of cases, the treatment of some concomitant problem in addition to the LBP, and/or may be associated with ongoing treatment in the 6 to 12-month period despite resolution of the initial LBP complaint.

Our study has several limitations. We were not able to reliably assess a number of common and recommended treatments such as patient education, advice to stay active, and nonsteroidal anti-inflammatory medications, many of which are over-the-counter. In addition, for active-duty service members, many encounters for LBP may occur without a formal visit claim appearing in the MDR. Moreover, there was no firm way to match the treatment with the index LBP diagnosis, therefore, some of the treatments may have been for other conditions that occurred with or shortly after the index diagnosis of LBP. Finally, our outcome measures—the absence of any additional claims indicating LBP or the absence of any additional claims indicating LBP plus any ongoing treatments associated with LBP—were only proxy measures for the resolution of LBP. Some beneficiaries may have continued to have LBP or had a recurrence but simply stopped seeking LBP care thereby overestimating the amount of LBP resolution.[18] Conversely, some of the ongoing treatments associated with LBP in our broader outcome measure may have picked up treatments for other conditions, thereby underestimating the amount of LBP resolution. The use of both outcome measures serves as a sensitivity analysis with the true rate of resolution likely falling somewhere in between. Finally, our use of area-level rates makes our results more relevant to policy-level questions rather than the effectiveness of specific treatments in individual patients.

➢ Key Points

- ❑ The most commonly received treatments in the first 3 months after LBP diagnosis across TriCare catchment areas were physical therapy (17%–39%), opioid prescription (15%–28%), and manual therapy (5%–26%).
- ❑ Higher rates of opioid prescription were consistently associated with worse outcomes across multiple different analytic approaches.
- ❑ Practice patterns for active-duty beneficiaries were more consistent with guideline recommendations (higher rates of nonpharmacologic interventions and lower rates of opioid and benzodiazepine prescription) but the catchment area rates of opioid prescription were still associated with worse outcomes when the analysis was restricted to active-duty beneficiaries.

CONCLUSIONS

Our study found substantial variability across catchment areas within TRICARE for the treatment of LBP. Higher rates of opioid prescription were consistently associated with worse outcomes across multiple different analytic approaches. Treatment patterns for active-duty beneficiaries were more consistent with guideline-recommended care but still showed relatively modest rates of nonpharmacologic treatments and rates of opioid and benzodiazepine prescribing that are likely higher than warranted.

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