JSES International 9 (2025) 511–516

Contents lists available at ScienceDirect

JSES International

journal homepage: www.jsesinternational.org

Limited health literacy does not adversely affect compliance with postoperative restrictions, 90-day emergency department return, or opioid use following shoulder arthroscopy

Cameron Smith, BA, MPH[a], Savino Stallone, BS[b], Suhirad Khokhar, MD[b], Eloy Tabeayo, MD[b], Yungtai Lo, PhD[c], Konrad I. Gruson, MD[b,*]

[a]Albert Einstein College of Medicine, Bronx, NY, USA
[b]Department of Orthopaedic Surgery, Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY, USA
[c]Department of Epidemiology and Population Health, Albert Einstein College of Medicine, Bronx, NY, USA

ARTICLE INFO

Keywords:
Shoulder arthroscopy
Rotator cuff
Return to emergency room
Postoperative surgical complications
Compliance
Musculoskeletal health literacy
Opioid use

Level of evidence: Level III; Retrospective Cohort Comparison; Prognosis Study

Background: Limited health literacy can negatively impact how patients process medical information, make medical decisions, and navigate the healthcare system. The literature with regards to health literacy and its impact on both postoperative compliance and healthcare utilization remains scant.
Methods: We retrospectively analyzed the records for patients who underwent elective shoulder arthroscopy with a minimum 90-day follow-up at a single academic institution. Demographic data including age, gender, prior ipsilateral shoulder arthroscopy, body mass index and age-adjusted Charlson Comorbidity Index were collected. A validated 9-item literacy in musculoskeletal problems questionnaire to assess musculoskeletal health literacy was administered preoperatively. Postoperative compliance with therapy and surgeon-directed immobilization restrictions, 90-day return to emergency department (ED), and the number of opioid prescriptions filled within 3 months postoperatively was recorded.
Results: There were 252 cases included in this study. Seventy-seven (31%) patients demonstrated adequate musculoskeletal health literacy (MHL). On multivariable analysis, limited MHL (LMHL) was not significantly associated with 90-day postoperative ED return, compliance with postoperative surgeon instructions regarding shoulder motion or therapy restrictions, or obtaining ≥2 postoperative opioid prescriptions.
Conclusions: LMHL is highly prevalent among patients undergoing elective shoulder arthroscopy. The lack of association between LMHL and postoperative compliance, 90-day ED return, or filling ≥2 postoperative opioid prescriptions suggests that further research is needed to identify more relevant modifiable risk factors that could reduce these negative clinical outcomes and healthcare utilization patterns.

Health literacy represents the manner in which a patient acquires, interprets, and utilizes information to make autonomous decisions that impact their health.[16,18] Limited health literacy (LHL) has been shown to be commonplace among adult Americans, in particular for older people and those with lower education.[2,12] In a systematic review of the prevalence of low health literacy in surgical patients, De Oliveira et al reported that orthopedic patients undergoing hip or knee replacement demonstrated the highest rate of LHL.[4] The authors surmised that lower health literacy could result in inadequate comprehension of surgical procedures and discharge instructions, potentially affecting patient safety and adherence to preoperative instructions. Risk factors for limited musculoskeletal health literacy (MHL) using the literacy in musculoskeletal problems (LiMP) questionnaire have been extensively studied among various orthopedic subspecialties.[15,23,24]

LHL has been surmised to play a role in patients experiencing worse clinical outcomes and higher utilization of healthcare resources. In a systematic review, Berkman et al reported that LHL, as measured by various validated instruments, was consistently

This study was approved by the Albert Einstein College of Medicine IRB Board (#2024-15871).

This study was conducted at the Montefiore Medical Center, Bronx, New York, USA.

*Corresponding author: Konrad I. Gruson, MD, Department of Orthopaedic Surgery, Albert Einstein College of Medicine, 1250 Waters Place, 11th Floor, Bronx, NY 10461, USA.
E-mail address: kgruson@montefiore.org (K.I. Gruson).

https://doi.org/10.1016/j.jseint.2024.08.197

associated with greater hospitalization rates, increased utilization of emergency care services, substandard overall health status, and greater mortality.[1] In a prospective cohort study, Shahid et al found that patients admitted to general internal medicine units with LHL were more likely to revisit the emergency room compared to patients with adequate health literacy.[26] Puzzitiello et al completed a retrospective institutional database study of patients undergoing elective shoulder arthroplasty and reported a significant association between LHL and increased preoperative opioid use, worse baseline ASES scores, and higher visual analog scale pain scores.[19] However, there were no differences identified in terms of inpatient opioid consumption, inpatient costs, or discharge disposition. Furthermore, in a study of patients undergoing treatment for back pain, patients with LHL were reported to use more medications for chronic pain, were less likely to visit a specialist, and more likely to visit a chiropractor.[6] The discordant results within the existing literature regarding the association between health literacy and resource utilization suggest that other patient- or disease-related factors may have a more direct impact on resource utilization patterns.

Therefore, the primary objectives of the current study were to determine the association between LMHL and 1) all-cause 90-day postoperative ED visits, 2) compliance with surgeon-specific postoperative instructions regarding shoulder motion, and 3) increased number of opioid prescriptions filled within 90 days following shoulder arthroscopy. Our secondary objective was to determine any patient- or surgical-related independent risk factors for 90-day ED visits, postoperative compliance, and increased opioid use following shoulder arthroscopy. We hypothesized that patients with LMHL were more likely to utilize the ED both pre- and postoperatively and exhibit higher rates of noncompliance with postoperative instructions.

Materials and methods

We completed a retrospective analysis of all elective arthroscopic rotator cuff-related shoulder procedures performed by a single fellowship-trained orthopedic surgeon between September 2019 and November 2023 at a single tertiary-referral teaching hospital. This study was approved by our institutional review board [#2024-15871]. We included all patients who underwent an elective rotator cuff-related shoulder arthroscopy, with a minimum 90-day follow-up period. Patients younger than 18 years at the time of the procedure, those who underwent shoulder arthroscopy for instability or infection, and those with incomplete demographic or baseline patient-reported outcome measures were excluded from the study.

The electronic health records (EHRs) were used to obtain demographic data, including patient gender, age, self-identified race, marital status, distance from home to clinic, body mass index , preferred spoken language (English vs. Spanish vs. other), documented depression and/or anxiety, the number of preoperative outpatient visits attended with the operating surgeon, the presence of missed preoperative outpatient visits, insurance type (Medicaid vs. Medicare vs. commercial vs. workers compensation), smoking status (never vs. former vs. current), age-adjusted Charlson Comorbidity Index , and 90-day postoperative presentations to the ED. Any patient visit to the ED within 12 months prior to shoulder arthroscopy was also determined given a prior publication reporting on its association with 90-day postoperative ED visits.[29] For the purpose of assessing the potential influence of the complexity of the arthroscopic procedure performed with our outcome measures, we categorized them as: type 1: rotator cuff débridement with distal clavicle resection and/or biceps tenodesis; type 2: rotator cuff repair with decompression alone; type 3: rotator cuff repair with decompression and distal clavicle resection and/or biceps tenodesis. All procedures were performed under a combination of regional and either general anesthesia vs. sedation. Patient sociodemographic status was established via the state-level and national-level area deprivation index, wherein lower values represent lower levels of socioeconomic disadvantage.[10,28]

In order to determine baseline MHL, participants completed the LiMP questionnaire, a validated nine-item multiple choice survey that assesses a patient's knowledge of musculoskeletal anatomy, conditions, and terminology.[23] A score $\geq$6 denotes adequate MHL and a score <6 represents LMHL. Each patient indicated for surgical intervention had a dedicated preoperative outpatient visit scheduled with a certified health education specialist (CHES). The CHES has achieved advanced certification beyond the bachelor's degree and, in our practice, has been tasked with assisting our patients with all facets of their pre- and postoperative health needs. During the initial visit, the anticipated perioperative course was discussed in depth with the patient and their family members specifically regarding the following: 1) the appropriate duration of use and positioning of the abduction sling; 2) timing of initiation of physical therapy (PT) following surgery and the various phases; and 3) perioperative pain management. Furthermore, each patient and family member was provided with the cell phone number and e-mail address of the CHES should any urgent issues arise. With regards to PT, the specifics of each phase of therapy were discussed at length with each patient prior to initiating that phase, and a therapy referral reflecting those restrictions was provided for the therapist. A handout with respect to those instructions was also provided to each patient. Patients were routinely evaluated within 1 week postoperatively, at 3-4 weeks, and at 6 weeks when sling use was discontinued.

Clinical outcome measures

90-day ED return

The EHR was queried to determine whether the patient returned to the ED for any reason within 90 days following shoulder arthroscopy. Each visit was broadly categorized as either medical or surgical in nature. Surgical reasons involved surgical site complications and/or pain, whereas medical reasons were denoted by the organ system affected.

Compliance with movement restrictions

At each postoperative visit, patients were systematically queried as to whether they were wearing their sling as instructed and whether they were compliant with the operative shoulder surgeon-imposed motion restrictions. While those instances where patients removed only the abduction portion of the sling on their own for an extended period of time or presented without the abduction pillow were recorded, we did not consider this noncompliance. After therapy was initiated, patients were asked to demonstrate which specific exercises they were performing and from what body position (supine or standing). Their responses were then compared with the written PT referral provided and the actual therapist progress notes. This comparison was performed to minimize the risk of patient recall bias. Any deviation from the prescribed therapy instructions was categorized as noncompliance. In the current study, the reasons for noncompliance were categorized broadly as follows: 1) lack of sling use; 2) early active shoulder motion discordant with surgeon instructions; 3) attendance at formal therapy <50% of scheduled visits; and 4) performance of exercises with therapist that was discordant with written and verbal surgeon instructions.

Increased postoperative opioid use

The number of pre- and postoperative opioid prescriptions was determined 3 months before and after shoulder arthroscopy. This prescription data was determined from the EHR, as well as the New York State prescription monitoring program online database. During the study period, each postoperative opioid prescription encompassed 30 tablets. Similar to prior authors, increased opioid use was defined as ≥2 postoperative prescriptions filled.[17]

Statistical analysis

Continuous variables were presented as either a mean and standard deviation or median and associated interquartile range (IQR). Differences in demographic and medical characteristics between patients with and without adequate health literacy were compared using the Wilcoxon rank-sum or Kruskal–Wallis tests for continuous variables and chi-squared or Fisher's exact tests for categorical variables. Logistic regression analysis was used to identify factors independently associated with 90-day postoperative ED visits, increased postoperative opioid prescriptions, and compliance with postoperative instructions, which was presented as an odds ratio (OR) with 95% confidence intervals (CI). Apart from MHL, only variables with a *P*-value <.25 in initial analyses were included in regression analysis. A *P*-value <.05 was considered statistically significant. All statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA).

Results

A total of 252 patients met the inclusion criteria, of which 175 (69.4%) were categorized as having LMHL. The mean age of the cohort was 56.7 ± 8.8 years and the dominant shoulder was involved in 53% of the cases. Patients with LMHL were less likely to have at least a college degree and more likely to have a clinical mental health diagnosis. The remainder of the patient demographics is given (Table I).

90-day return to ED

There were 29 (11.5%) patients who experienced a 90-day return to the ED, comprising 38 total visits. Of the total visits, 10 occurred within 7 days postoperatively, 5 occurred between 8 and 30 days postoperatively, and 23 occurred between 31 and 90 days after surgery. There were 8 visits ≤7 days for surgical reasons compared with 0 during the 31-90-day period ($P < .00001$). All of the surgical visits ≤7 days were for surgical site pain. Adequacy of MHL demonstrated no significant association with 90-day ED return. Patients with a mental health diagnosis (OR 2.56, 95% CI 1.04-6.28, $P = .041$) and those with ≥3 preoperative ED visits within 12 months prior to surgery (OR 26.81, 95% CI 5.32-135.19, $P < .001$) were significantly more likely to experience a 90-day return to the ED following shoulder arthroscopy (Table II).

Compliance with postoperative instructions

There were 144 (57.1%) patients who were deemed noncompliant in the 90-day postoperative period. Of these, 11 patients (4.4%) were deemed noncompliant with regards to sling use, 65 patients (25.8%) initiated early shoulder motion despite surgeon-placed restrictions, 41 (16.3%) participated in <50% of prescribed PT visits, and 27 (10.7%) performed exercises during therapy that were incongruent with the written referral and in-office education. If the latter category were removed, noncompliance was noted in 108 patients (42.9%). Of note, 38 patients did not adhere to instructions regarding the use of abduction portion of the sling. Regardless of whether PT noncompliance was included, having worker's compensation or commercial insurance was significantly associated with postoperative instruction compliance, while having missed a preoperative visit was associated with an increased risk for noncompliance. There was no significant association between MHL and postoperative compliance issues (Tables III and IV).

Postoperative opioid prescriptions

There were 32 patients (13%) of the cohort that had filled an opioid prescription within 3 months prior to undergoing shoulder arthroscopy. Postoperatively, the median number of opioid prescriptions was 1 (IQR 1,2). There was no significant association between MHL and having received ≥2 opioid prescriptions within 90 days postoperatively. In contrast, however, current smokers (OR 2.38, 95% CI 1.13-4.99; $P = .022$) and those who missed a preoperative visit (OR 3.98, 95% CI 1.76-8.99; $P < .001$) were more likely to receive ≥2 opioid prescriptions postoperatively, whereas married patients were less likely to receive (OR 0.54, 95% CI 0.30-0.96; $P = .035$) (Table V).

Discussion

LHL can often lead to difficulty comprehending medical information, resulting in improper utilization of healthcare services and potentially adverse outcomes. The primary findings of this single institution study were that LMHL was not associated with 90-day return to ED, receiving ≥2 postoperative opioid prescriptions, and compliance with restrictions with regards to early active shoulder use or adherence to surgeon-imposed PT protocols.

We found that LMHL was not associated with 90-day ED return following shoulder arthroscopy. Similar to our findings, Wright et al found no association between LHL and 30-day postoperative ED visits in patients undergoing major abdominal surgery.[31] In contrast, Shahid et al found that patients with LHL on general internal medicine units were more likely to revisit the ED within 90 days of discharge.[26] Griffey et al, in a retrospective single institution cohort study, found that patients with inadequate health literacy had higher ED utilization than those with adequate health literacy, and that inadequate health literacy was associated with at least one return ED visit within 14 days.[7] Neither of the latter studies, however, involved postsurgical patients, which may have resulted in the difference from our findings. Following regression analysis, we found that having a diagnosis of depression and/or anxiety and having ≥3 ED visits preoperatively was significantly associated with a 90-day ED return following shoulder arthroscopy, whereas being a former smoker was associated with a lower risk for 90-day ED return. Johnson et al also reported that patients diagnosed with depression and/or anxiety were more likely to experience a postoperative 90-day ED visit after rotator cuff repair. However, following regression analysis, a mental health disorder was independently associated with complications and persistent pain following arthroscopy, though the relationship with 90-day ED visit was no longer significant.[8] Williams et al found that nonsmokers were significantly less likely to present to the ED or urgent care center within 30 days of their orthopedic procedure.[30] Of note, the most common reason for ED return ≤7 days in the current study was surgical site pain. Similarly, Raji et al found that postoperative pain was the most common reason for ED return ≤7 days following arthroscopic rotator cuff surgery,[21] a problem that can be remedied without the need for an ED visit in most cases. These findings suggest that more focus should be placed on a patient's mental health issues and frequent preoperative ED use, as opposed to MHL, in order to reduce the risk for 90-day postoperative ED return.

Table I
Baseline patient characteristics and clinical variables by MHL score.

	MHL score ≥ 6	MHL score < 6	*P*-value
	N = 77	N = 175	
Age, mean ± SD	57.1 ± 8.3	56.5 ± 9.0	.602
BMI, median (IQR)	30.5 (27.5, 34.4)	31.0 (26.8, 35.3)	.810
Operative time, median (IQR)	95 (74, 109)	91 (71, 108)	.541
Number of implants, median (IQR)	3 (2, 4)	3 (2, 4)	.085
ACCI, median (IQR)	2 (1, 3)	2 (1, 3)	.394
Distance from hospital, median (IQR)	2.8 (1.7, 4.2)	2.8 (2.1, 3.9)	.656
Area deprivation index state decile, median (IQR)	5 (4, 6)	6 (4, 6)	.199
Area deprivation index national (%), median (IQR)	23 (15, 29)	25 (16, 29)	.239
Preop visits, median (IQR)	3.5 (2, 5)	3 (3, 5)	.890
Arthroscopy procedure			.464
Type 1	5 (6.5)	21 (12.0)	
Type 2	26 (33.8)	55 (31.4)	
Type 3	46 (59.7)	99 (56.6)	
Highest education achieved, n (%)			<.001
<College	37 (48,1)	144 (82.3)	
≥College	40 (51.9)	31 (17.7)	
Dominant side, n (%)			.988
No	36 (46.7)	82 (46.9)	
Yes	41 (53.3)	93 (53.1)	
Gender, n (%)			.605
Female	36 (46.7)	88 (50.3)	
Male	41 (53.3)	87 (48.7)	
Marital status, n (%)			.286
No	42 (54.6)	108 (61.7)	
Yes	35 (45.4)	67 (38.3)	
Preferred language, n (%)			.112
English	70 (90.9)	142 (81.1)	
Spanish	7 (9.1)	29 (16.6)	
Other	0	4 (2.3)	
Self-identified ethnicity, n (%)			.277
White	15 (19.5)	17 (9.7)	
Black	27 (35.1)	60 (34.3)	
Hispanic	30 (38.9)	82 (46.8)	
Asian	3 (3.9)	8 (4.6)	
Other	2 (2.6)	8 (4.6)	
Depression or anxiety, n (%)			.021
No	64 (83.1)	121 (69.1)	
Yes	13 (16.9)	54 (30.9)	
Work status, n (%)			.002
Unemployed	15 (19.5)	54 (30.9)	
Physical laborer	28 (36.3)	51 (29.1)	
Office worker	19 (24.7)	14 (8.0)	
Disabled	6 (7.8)	28 (16.0)	
Retired	9 (11.7)	28 (16.0)	
Worker's compensation, n (%)			.661
No	70 (90.9)	155 (89.1)	
Yes	7 (9.1)	19 (10.9)	
ASA			.203
1,2	51 (66.2)	101 (57.7)	
≥3	26 (33.8)	74 (42.3)	
Smoking, n (%)			.139
Never	50 (64.9)	90 (51.4)	
Former	17 (22.1)	54 (30.9)	
Current	10 (13.0)	31 (17.7)	
Insurance type, n (%)			<.001
Medicare	14 (18.2)	56 (32.0)	
Medicaid	13 (16.9)	57 (32.6)	
Commercial	43 (55.8)	43 (24.6)	
Worker's compensation	7 (9.1)	19 (10.8)	
Missed preop visit prior to OR, n (%)			.816
No	32 (41.6)	70 (40)	
Yes	45 (58.4)	105 (60)	
Prior contralateral shoulder arthroscopy, n (%)			.831
No	58 (75.3)	134 (76.6)	
Yes	19 (24.7)	41 (23.4)	
Prior ipsilateral shoulder arthroscopy, n (%)			.506
No	63 (81.8)	149 (85.1)	
Yes	14 (18.2)	26 (14.9)	
Preop opioid use, n (%)			.616
No	66 (85.7)	154 (88)	
Yes	11 (14.3)	21 (12)	
Preop ED visit within 1 year of surgery, n (%)			.306
No	51 (66.2)	104 (59.4)	
Yes	26 (33.8)	71 (40.6)	
Preop ED visits within 1 year of surgery, n (%)			.259
0	51 (66.2)	104 (59.4)	
1-2	25 (32.5)	61 (34.9)	
>3	1 (1.3)	10 (5.7)	
Return to ED in 90 days post-surgery, n (%)			.712
No	69 (89.6)	154 (88)	
Yes	8 (10.4)	21 (12)	
Compliance without PT issues, n (%)			1.0
No	44 (57.1)	100 (57.1)	
Yes	33 (42.9)	75 (42.9)	
Compliance with PT issues, n (%)			.373
No	39 (50.6)	78 (44.6)	
Yes	38 (49.4)	97 (55.4)	
Number of postop opioid prescriptions in 3 months, n (%)			.137
0-1	55 (71.4)	108 (61.7)	
>2	22 (28.6)	67 (38.3)	

BMI, Body Mass Index; *VAS*, Visual Analog Scale; *ACCI*, Age-adjusted Charleson Comorbidity Index; *ASA*, American Society of Anesthesiologists; *ED*, Emergency Department; *PT*, Physical Therapy; *IQR*, interquartile range; *SD*, standard deviation.

We found no significant association between MHL and postoperative compliance with either self-directed early active shoulder use or with PT instructions. To our knowledge, there are no current studies directly examining this relationship in the existing orthopedic literature. Kadakia et al, in a prospective cohort study examining orthopedic patients discharged from a level 1 trauma center, found an overall limited comprehension of the injury sustained, surgery performed, and postoperative instructions.[9] The authors used educational level as a surrogate for health literacy and reported significantly worse comprehension among patients with lower education. A subsequent study by the same authors found that the use of text and pictorial intervention resulted in a significant improvement in postdischarge instruction comprehension compared with verbal instructions alone.[27] Garfinkel et al reported a high level of comprehension and retention of instructions provided during a preoperative outpatient visit 1-2 weeks prior to a Lapidus procedure, though the majority of their cohort was comprised of patients with higher than a college education.[5] The authors recommended clear standardized instructions preoperatively, with reinforcement throughout the postoperative period. In contrast to our results, Qin et al found that patients with LHL were less likely to adhere to

Table II
Factors associated with 90-day ED return after shoulder arthroscopy on multivariable logistic regression.

Characteristic	Adjusted odds ratio (95% CI)	*P* value
MHL score		
<6	0.89 (0.35-2.25)	.802
≥6 (reference)	1	
Depression or anxiety		
Yes	2.56 (1.04-6.28)	.041
No (reference)	1	
Smoking		
Current	0.24 (0.05-1.03)	.055
Former	0.33 (0.11-0.99)	.047
Never (reference)	1	
ED visit 12 months prior to surgery		
≥3	26.81 (5.32-135.19)	<.001
1-2	2.28 (0.94-5.57)	.070
0 (reference)	1	

MHL, Musculoskeletal Health Literacy; *ED*, Emergency Department; *CI*, confidence interval.

Table III
Factors associated with compliance without PT issues on multivariable logistic regression.

Characteristic	Adjusted odds ratio (95% CI)	*P* value
MHL score		
<6	1.32 (0.73-2.40)	.365
≥6 (reference)	1	
Insurance type		
Medicare	1.77 (0.86-3.67)	.122
Commercial	3.31 (1.62-6.78)	.001
Worker compensation	6.25 (2.28-17.09)	<.001
Medicaid (reference)	1	
Missed preop visit prior to operating room		
Yes	0.47 (0.28-0.81)	.007
No (reference)	1	

MHL, Musculoskeletal Health Literacy; *CI*, confidence interval; *PT*, physical therapy; *OR*, Operating Room.

Table IV
Factors associated with compliance with PT issues on multivariable logistic regression.

Characteristic	Adjusted odds ratio (95% CI)	*P* value
MHL score		
<6	1.73 (0.95-3.15)	.075
≥6 (reference)	1	
Insurance type		
Medicare	0.92 (0.47-1.82)	.811
Commercial	2.31 (1.16-4.59)	.017
Worker compensation	5.36 (1.77-16.26)	.003
Medicaid (reference)	1	
Missed preop visit prior to operating room		
Yes	0.48 (0.28-0.82)	.007
No (reference)	1	

MHL, Musculoskeletal Health Literacy; *CI*, confidence interval; *PT*, physical therapy; *OR*, Operating Room.

Table V
Factors associated with ≥2 postoperative opioid prescriptions on multivariable logistic regression.

Characteristic	Adjusted odds ratio (95% CI)	*P* value
MHL score		
<6	1.51 (0.81-2.80)	.196
≥6 (reference)	1	
Marital status		
Yes	0.54 (0.30-0.96)	.035
No (reference)	1	
Smoking		
Current	2.38 (1.13-4.99)	.022
Former	1.38 (0.73-2.62)	.320
Never (reference)	1	
Preop opioid use		
Yes	3.98 (1.76-8.99)	<.001
No (reference)	1	

MHL, Musculoskeletal Health Literacy; *CI*, confidence interval.

enhanced recovery after surgery protocols for perioperative care regarding colorectal surgery.[20] A prior meta-analysis assessing the association between health literacy and adherence to medical treatment reported a positive correlation between these parameters.[13] Importantly, they found that health literacy interventions were effective in improving adherence to treatment. The current study was not designed to assess the effect of the CHES on postoperative compliance and a more robust study design is warranted. Finally, we found that missing a preoperative outpatient visit was significantly associated with postoperative noncompliance, with motion restrictions and adherence to PT protocols. Closer follow-up during the early postoperative course with reinforcement of instructions, particularly among patients who missed preoperative visits, could potentially improve compliance with postoperative instructions and result in improved clinical outcomes.

We found no significant relationship between LMHL and receiving ≥2 opioid prescriptions postoperatively. Within our cohort, there was a median of 1 postoperative opioid prescription provided. Our finding was consistent with those who previously reported following orthopedic procedures.[14,19] Puzzitiello et al reported no difference in inpatient total inpatient morphine equivalents between patients with and without LHL.[19] Narayanan et al, using the LiMP questionnaire to assess health literacy following total knee arthroplasty, found no difference in the number of opioid prescriptions provided within 3 months following surgery between patient with and without LMHL.[14] In contrast, a prior study demonstrated that LHL was associated with an increased rate of receiving opioids in the ED, receipt of an opioid prescription, and use of opioids in the week following discharge from the ED among patients presenting to the ED with musculoskeletal complaints.[3] That study dealt with nonsurgical patients, and the discordant findings could certainly be a function of the multimodal pain management strategy utilized in the outpatient surgical setting.[25] Furthermore, our results may reflect the general trend toward reduced opioid prescribing following the implementation of the state-mandated prescription monitoring program program.[22] We further found that current smokers and those using opioids preoperatively were more likely and married patients were 46% less likely to receive ≥2 opioid prescriptions postoperatively. Okoli et al, in a retrospective institutional study, found that current smoking status and preoperative opioid use were independent risk factors for filling a second opioid prescription following outpatient orthopedic surgery.[17] Others have demonstrated similar findings following spine surgery.[11] Providing perioperative counseling regarding the use of postoperative opioid medication, in addition to the use of multimodal strategies for postoperative pain control, particularly among current smokers and those using opioids preoperatively, may reduce the need for multiple postoperative opioid prescriptions.

Limitations to our current study include those inherent to performing a single institution retrospective review. Specifically, with regard to the preoperative use of opioids, we did not quantify the number of preoperative prescriptions allotted to the patient or the exact reason for which the opioid medications were being taken. Furthermore, the number of tablets actually taken postoperatively could not be determined given the retrospective nature of the study design. Additionally, the diagnosis of anxiety and/or depression was

based on documentation within the EHR opposed to validated questionnaires assessing mental health status. It is possible that postoperative patients were evaluated in an urgent care center or emergency room unaffiliated with our institution. However, we believe this number to be quite small given the fact that the vast majority of the included patients receive their primary care needs through our hospital system. Finally, with regard to early use of the operative extremity by the patient, our results could certainly have been affected by recall bias in that patients could not accurately recall their postoperative behavior. Similarly, our results are susceptible to social desirability bias in that patients may over-report compliance with postoperative instructions so as to be viewed favorably by the treating surgeon. Strength of the current study includes the fact that a validated assessment for health literacy was utilized. Furthermore, our study included numerous patient- and surgery-related predictive factors, including measures of socioeconomic status.

Conclusions

Adequate patient health literacy is imperative for effective shared decision-making and, ultimately, for achieving optimal clinical outcomes. Despite a high prevalence for LMHL in the current study, there was no association between LMHL and compliance with postoperative instructions, 90-day return to the ED, or an increased number of postoperative opioid prescriptions. Further research into interventions aimed at the other patient- or surgery-related factors associated with increased 90-day ED return and noncompliance with postoperative instructions is warranted.

Disclaimers:

Funding: This study was funded by Montefiore Medical Center, Department of Orthopaedic Surgery Seed Grant, Grant #0008.
Conflicts of interest: Konrad I. Gruson, MD discloses paid consultant/stock ownership with Smith & Nephew and Stryker. Dr. Gruson received consultant payments from Smith & Nephew, which is related to the subject of this work. None of the other authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article.

References

1. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. Ann Intern Med 2011;155:97-107. https://doi.org/10.7326/0003-4819-155-2-201107190-00005.
2. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Viera A, Crotty K, et al. Health literacy interventions and outcomes: an updated systematic review. Evid Rep Technol Assess 2011;199:1-941.
3. Dayaa JA, Bush M, Richmond NL, Nelson LS, Platts-Mills TF. Patient health literacy and the receipt of opioids in the emergency department. J Opioid Manag 2019;15:267-71. https://doi.org/10.5055/jom.2019.0511.
4. De Oliveira GS Jr, McCarthy RJ, Wolf MS, Holl J. The impact of health literacy in the care of surgical patients: a qualitative systematic review. BMC Surg 2015;15:86. https://doi.org/10.1186/s12893-015-0073-6.
5. Garfinkel JH, Hummel A, Day J, Roney A, Jones M, Rosenbaum A, et al. Health literacy and recall of postoperative instructions in patients undergoing the Lapidus procedure. Foot Ankle Orthop 2020;5:2473011420940221. https://doi.org/10.1177/2473011420940221.
6. Glassman SD, Carreon LY, Brown ME, Jones JS, Edward J, Li J, et al. The impact of health literacy on health status and resource utilization in lumbar degenerative disease. Spine J 2019;19:711-6. https://doi.org/10.1016/j.spinee.2018.10.012.
7. Griffey RT, Kennedy SK, D'Agostino McGowan L, Goodman M, Kaphingst KA. Is low health literacy associated with increased emergency department utilization and recidivism? Acad Emerg Med 2014;21:1109-15. https://doi.org/10.1111/acem.12476.
8. Johnson AH, York JJ, Lashgari CJ, Petre BM, Turcotte JJ, Redziniak DE. Effects of preexisting depression and anxiety on postoperative outcomes following arthroscopic rotator cuff repair. JSES Int 2022;6:984-8. https://doi.org/10.1016/j.jseint.2022.07.005.
9. Kadakia RJ, Tsahakis JM, Issar NM, Archer KR, Jahangir AA, Sethi MK, et al. Health literacy in an orthopedic trauma patient population: a cross-sectional survey of patient comprehension. J Orthop Trauma 2013;27:467-71. https://doi.org/10.1097/BOT.0b013e3182793338.
10. Kind AJH, Buckingham W. Making neighborhood disadvantage metrics accessible: the neighborhood atlas. N Engl J Med 2018;378:2456-8. https://doi.org/10.1056/NEJMp1802313.
11. Kowalski C, Ridenour R, McNutt S, Ba D, Liu G, Bible J, et al. Risk factors for prolonged opioid use after spine surgery. Global Spine J 2023;13:683-8. https://doi.org/10.1177/21925682211003854.
12. Kutner M, Greenberg E, Jin Y, Paulsen C. The health literacy of America's adults: Results from the 2003 national assessment of adult literacy (NCES 2006–483). Washington, DC: U.S. Department of Education; 2006. National Center for Education Statistics.
13. Miller TA. Health literacy and adherence to medical treatment in chronic and acute illness: a meta-analysis. Patient Educ Couns 2016;99:1079-86. https://doi.org/10.1016/j.pec.2016.01.020.
14. Narayanan AS, Stoll KE, Pratson LF, Lin FC, Olcott CW, Del Gaizo DJ. Musculoskeletal health literacy is associated with outcome and satisfaction of total knee arthroplasty. J Arthroplasty 2021;36:S192-7. https://doi.org/10.1016/j.arth.2021.02.075.
15. Noback PC, Seetharaman M, Tantigate D, Strauch RJ, Rosenwasser MP, Vosseller JT. Prevalence and risk factors of limited musculoskeletal health literacy in the outpatient setting: a logistic regression model. J Am Acad Orthop Surg 2018;27:e491-8. https://doi.org/10.5435/JAAOS-D-17-00712.
16. Nutbeam D, Lloyd JE. Understanding and responding to health literacy as a social determinant of health. Annu Rev Public Health 2021;42:159-73. https://doi.org/10.1146/annurev-publhealth-090419-102529.
17. Okoli MU, Rondon AJ, Townsend CB, Sherman MB, Ilyas AM, Opioid Use in Orthopaedic Surgery Study Group. Comprehensive analysis of opioid use after common elective outpatient orthopaedic surgeries. J Am Acad Orthop Surg Glob Res Rev 2022;6:e21.00226. https://doi.org/10.5435/JAAOSGlobal-D-21-00226.
18. Parker R, Ratzan SC. Health literacy: a second decade of distinction for Americans. J Health Commun 2010;15:20-33. https://doi.org/10.1080/10810730.2010.501094.
19. Puzzitiello RN, Colliton EM, Swanson DP, Menendez ME, Moverman MA, Hart PA, et al. Patients with limited health literacy have worse preoperative function and pain control and experience prolonged hospitalizations following shoulder arthroplasty. J Shoulder Elbow Surg 2022;31:2473-80. https://doi.org/10.1016/j.jse.2022.05.001.
20. Qin PP, Jin JY, Min S, Wang WJ, Shen YW. Association between health literacy and enhanced recovery after surgery protocol adherence and postoperative outcomes among patients undergoing colorectal cancer surgery: a prospective cohort study. Anesth Analg 2022;134:330-40. https://doi.org/10.1213/ANE.0000000000005829.
21. Raji Y, Vakharia AM, Chen M, Sivasundaram L, Wang JH, Salata MJ, et al. Emergency department utilization is low after outpatient elective rotator cuff repair. J Am Acad Orthop Surg 2022;30:e547-60. https://doi.org/10.5435/JAAOS-D-21-00890.
22. Reid DBC, Shah KN, Shapiro BH, Ruddell JH, Akelman E, Daniels AH. Mandatory prescription limits and opioid utilization following orthopaedic surgery. J Bone Joint Surg Am 2019;101:e43. https://doi.org/10.2106/JBJS.18.00943.
23. Rosenbaum AJ, Pauze D, Pauze D, Robak N, Zade R, Mulligan M, et al. Health literacy in patients seeking orthopaedic care: results of the literacy in musculoskeletal problems (LIMP) project. Iowa Orthop J 2015;35:187-92.
24. Rosenbaum AJ, Tartaglione J, Abousayed M, et al. Musculoskeletal health literacy in patients with foot and ankle injuries: a cross-sectional survey of comprehension. Foot Ankle Spec 2016;9:31-6. https://doi.org/10.1177/1938640015593078.
25. Rucinski K, Cook JL. Effects of preoperative opioid education on postoperative opioid use and pain management in orthopaedics: a systematic review. J Orthop 2020;20:154-9. https://doi.org/10.1016/j.jor.2020.01.020.
26. Shahid R, Shoker M, Chu LM, Frehlick R, Ward H, Pahwa P. Impact of low health literacy on patients' health outcomes: a multicenter cohort study. BMC Health Serv Res 2022;22:1148. https://doi.org/10.1186/s12913-022-08527-9.
27. Tsahakis JM, Issar NM, Kadakia RJ, Archer KR, Barzyk T, Mir HR. Health literacy in an orthopaedic trauma patient population: improving patient comprehension with informational intervention. J Orthop Trauma 2014;28:e75-9. https://doi.org/10.1097/BOT.0b013e3182a66921.
28. University of Wisconsin School of Medicine Public Health. 2019 Area Deprivation Index, 2022. Available at: https://www.neighborhoodatlas.medicine.wisc.edu/. [Accessed 15 March 2024].
29. Werner BC, Bustos FP, Gean RP, Deasey MJ. Emergency department visits in the year prior to total shoulder arthroplasty as a risk factor for postoperative emergency department visits. HSS J 2021;17:200-6. https://doi.org/10.1177/1556331621995775.
30. Williams BR, Smith LC, Only AJ, Parikh HR, Swiontkowski MF, Cunningham BP. Unplanned emergency and urgent care visits after outpatient orthopaedic surgery. J Am Acad Orthop Surg Glob Res Rev 2021;5:e21.00209. https://doi.org/10.5435/JAAOSGlobal-D-21-00209.
31. Wright JP, Edwards GC, Goggins K, Tiwari V, Maiga A, Moses K, et al. Association of health literacy with postoperative outcomes in patients undergoing major abdominal surgery. JAMA Surg 2018;153:137-42. https://doi.org/10.1001/jamasurg.2017.3832.