Pain associated psychological distress is more strongly associated with shoulder pain and function than tear severity in patients undergoing rotator cuff repair

Chinedu Okafor, BA, MS[a,*], Jay M. Levin, MD, MBA[b], Prince Boadi, BS[a], Chad Cook, PhD[b], Steven George, PhD[b], Chris Klifto, MD[b], Oke Anakwenze, MD, MBA[b]

[a]Duke University School of Medicine, Durham, NC, USA
[b]Department of Orthopaedic Surgery, Duke University Hospital, Durham, NC, USA

Background: Psychological distress has been associated with declining shoulder function in patients with rotator cuff tears (RCTs). Thus, we aimed to 1) evaluate the absence or presence of differences in shoulder pain, function, or pain-associated psychological distress in patients with increasing RCT severity and 2) assess whether psychological distress is associated with shoulder pain and function while adjusting for RCT severity.

Methods: Consecutive patients who underwent rotator cuff repair and completed the optimal screening for prediction of referral and outcome (OSPRO) survey from 2019 to 2021 were included. OSPRO is composed of 3 domains that estimate pain associated psychological distress (negative mood, negative coping, and positive coping). Demographics, tear characteristics, and three patient reported outcomes (PRO), including the visual analog scale (VAS), Single Assessment Numeric Evaluation, and American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) were collected. Patients were analyzed with analysis of variance and chi-square tests and stratified based on severity of RCTs into three groups: partial-thickness, small-to-medium full-thickness, and large-to-massive full-thickness tear. Linear regression analysis was used to evaluate the association between OSPRO scores and PROs, adjusting for severity of RCT.

Results: Eighty-four patients were included: 33 (39%) had partial-thickness, 17 (20%) had small-to-medium full-thickness, and 34 (41%) had large-to-massive tears. Regarding PROs and psychological distress, there were no significant differences amongst the three cohorts. In contrast, multiple significant associations between psychological distress and PROs were found. Within the negative coping domain, fear avoidance dimensions demonstrated the strongest correlation to PROs: fear-avoidance behavior for physical activity (ASES Beta -0.592, $P < .001$; VAS 0.357, $P < .001$) and work (ASES Beta -0.442, $P < .001$; VAS 0.274, $P = .015$). Several other dimensions within the negative coping, negative mood, and positive coping domains also demonstrated significant associations to PROs.

Discussion: These findings suggest that in patients undergoing arthroscopic rotator cuff repair, preoperative psychological distress can more strongly influence patient perception of shoulder pain and diminished shoulder function than RCT severity.

Psychological distress has become increasingly recognized as a significant contributor to patient perception of pain and disability in individuals with various orthopedic complications.[2,4,5,17,23,25] Shoulder pathology is one such complication where there is a complex interplay between degree of psychological distress and severity of shoulder pathology, which ultimately influences a patient's self-assessment of pain, function, and disability level.[17] We define this pain-associated psychological distress as reported negative emotions that influence patients' rehabilitation post-rotator cuff repair. Several studies have shown a substantial contribution of negative predictors of mental health with outcomes after shoulder surgery.[2,4,5,17,23,25] Patients with higher scores on the hospital anxiety and depression scales, Center for Epidemiological Studies Depression Scale,[18] and distress risk assessment method[15]

reported increased shoulder pain on the inferior simple shoulder test, visual analog scale (VAS), American of Shoulder and Elbow Surgeons (ASES), and disabilities of the arm, shoulder and hand scores when compared with nondistressed patients. Despite these findings, there are few published studies that have specifically examined the impact of rotator cuff tear (RCT) severity and preoperative psychological distress on shoulder pain and function in patients undergoing operative management for RCT. With up to two-thirds of RCTs being asymptomatic,[9,16,20,21,27] other factors such as psychological distress may contribute towards the perception of symptom severity in RCT pathology.

The optimal screening for prediction of referral and outcome assessment tool (OSPRO) is a brief assessment tool that allows for accurate estimates of patient-specific depressive symptoms, anxiety, anger, fear-avoidance beliefs, kinesiophobia, catastrophizing, self-efficacy, and pain acceptance.[10] The OSPRO provides score estimates for 11 commonly utilized patient questionnaires, such as the Patient Health Questionnaire-9 and the Chronic Pain Acceptance Questionnaire. The OSPRO has been used in multiple patient cohorts to identify psychological phenotypes and predict future healthcare utilization.[6,11,12] The OSPRO has also been used in patient's seeking care for shoulder pathology,[7] but its relationship to shoulder pain and function in patients specifically with rotator cuff pathology remains to be explored. Despite this, it is commonly understood that rotator cuff pathology such as a tear often results in a tandem of shoulder pain and diminished shoulder function. While the two do not always occur in unison, such as in cases of pseudo paralysis,[22] this is the common mechanism behind shoulder pain and decreased function in the setting of rotator cuff pathology.

The purpose of this study was to use the OSPRO tool to evaluate the association between preoperative psychological distress and shoulder pain and function in patients undergoing arthroscopic rotator cuff repair, with aims to identify which specific dimensions of psychological distress are most strongly associated with greater shoulder pain and diminished function. We also aimed to assess differences in shoulder pain, function, and pain-associated psychological distress across three RCT tear severity categories (partial thickness, small to medium full-thickness, and large to massive full thickness tears). We define shoulder pain-associated psychological distress as reported negative emotions that influence patients' rehabilitation postrotator cuff repair. We hypothesized that greater degree of psychological distress would be associated with higher level of shoulder pain and diminished shoulder function, while RCT severity would be insignificant in characterizing shoulder pain and function.

Materials and methods

Study design

This was a retrospective cross-sectional study of patients undergoing arthroscopic rotator cuff repair at a single academic institution. We used the reporting of studies conducted using observational routinely collected health data statement (which is an extension of STROBE) when working with and reporting data. This study received IRB exemption from the IRB: Pro00107189. No funding was obtained for this study.

Participants

Consecutive patients that underwent arthroscopic rotator cuff repair and completed preoperative OSPRO from 2019 to 2021 at a single academic institution were included. Patients selected in the study were: 1) diagnosed with a RCT who underwent rotator cuff

repair and 2) completed OSPRO questionnaire. Patient demographics and characteristics were collected, including age, gender, race, smoking status, body mass index, handedness, and laterality of the affected shoulder. Patients were stratified based on the severity of rotator cuff tendon tears into three groups based on arthroscopic evaluation: 1) partial-thickness tears, 2) small to medium full-thickness tears, and 3) large to massive full-thickness tears. Size of full thickness tear was classified using the DeOrio and Cofield classification system, which groups RCTs on the basis of greatest dimension as either small (<1 cm), medium (1–3 cm), large (3–5 cm), or massive (>5 cm).

Patient reported clinical outcomes were obtained from the same preoperative visit that the OSPRO survey was completed for each patient. 14 PROs were investigated in each patient and included the 11-part OSPRO as well as the ASES, single assessment numeric evaluation (SANE), and VAS shoulder pain scores. The ASES is comprised of eleven questions to analyze a patient's function, pain level, strength, and shoulder stability and ranges from 0 to 100, with lower scores reflecting greater pain and disability.[26] SANE encompasses patients rating their shoulder from 0% (completely abnormal) to 100% (completely normal).[26] Finally, VAS shoulder pain scale consists of a 100 mm horizontal line anchored with two opposite labels; patients mark a score on the scale using a vertical line.[3] Shoulder pain magnitude was evaluated using a numeric scale ranging from 0 ("no pain") to 10 ("worst pain").

Statistical analysis

All data were analyzed using IBM SPSS Statistics, Version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient characteristics. Chi-square analysis was used to compare categorical variables while analysis of variance was used to compare continuous variables, between the study groups. Multivariable linear regression analysis was utilized to assess the association between PROs (VAS pain, SANE, and ASES scores) with the individual OSPRO survey dimensions (i.e. depression, pain anxiety, pain self-efficacy, etc.), while adjusting for RCT severity. As such, a linear regression analysis was conducted for each individual OSPRO dimension, including the dimension and RCT severity as independent variables, and the PRO of interest as the dependent variable. Type 1 error rates less than 0.05 were considered statistically significant. Strength of the relationship between the variables was characterized based on the standardized coefficient from the regression analyses, where <0.3 is no to very weak, 0.3 to 0.5 is weak, 0.5 to 0.7 is moderate, and >0.7 is strong.

Results

Participants

Eighty-four total patients were included in this study. Thirty-three (39%) patients had a partial-thickness RCT, 17 (20%) patients had a small to medium full-thickness RCT, and 34 (41%) patients had a large to massive RCT (Table I).

Primary outcomes

Our analysis was powered by a two independent variables to one dependent variable model regression analysis. Regarding PRO scores, there were no significant differences amongst the three stratifications of RCT severity (Table II). Additionally, there were no significant differences found amongst the three tiers of RCT severity with regards to pain associated psychological distress as measured by the OSPRO (Table II). In other words, psychological distress did

Table I
Patient characteristics for single vs. multiple tendon RCT patients.

	Partial-thickness tear (n = 33)	Small to medium full-thickness tear (n = 17)	Large to massive full-thickness tear (n = 34)	P value
Age (years)	58.1 ± 11.6	61.3 ± 7.2	61.2 ± 10.0	.330
Gender (% male)	14 (42.4%)	5 (29.4%)	20 (58.8%)	.117
BMI (Kg/m^2)	30.0 ± 6.3	29.6 ± 6.0	29.2 ± 5.0	.849
Race				.002*
White	15 (45.5%)	6 (35.3%)	19 (55.9%)	
Black	18 (54.5%)	7 (41.2%)	15 (44.1%)	
Other	0 (0.0%)	4 (23.5%)[a]	0 (0.0%)	
Smoker	1 (3.0%)	2 (11.8%)	4 (11.8%)	.368
Handedness				.130
Right	25 (75.8%)	17 (100.0%)	31 (91.2%)	
Left	7 (21.2%)	0 (0.0%)	3 (8.8%)	
Bilateral	1 (3.0%)	0 (0.0%)	0 (0.0%)	
Affected shoulder				.338
Right	16 (48.5%)	11 (64.7%)	22 (64.7%)	
Left	17 (51.5%)	6 (35.3%)	12 (35.3%)	
Dominant shoulder affected	21 (63.6%)	11 (64.7%)	25 (73.5%)	.654

BMI, body mass index; RCT, rotator cuff tear.
*P value < .05.
[a] Denotes Z score > 1.96 on posthoc analysis using adjusted residuals. This indicates that the proportion of "Other" race in the small to medium full-thickness tear group is significantly different, and accounts for the chi-square test P value < .05.

Table II
Shoulder pain, function and estimates for psychological distress questionnaires based on the OSPRO survey.

	Partial-thickness tear (n = 33)	Small to medium full-thickness tear (n = 17)	Large to massive full-thickness tear (n = 34)	P value
VAS shoulder pain	6.46 ± 2.55	5.44 ± 2.68	5.38 ± 2.23	.168
SANE	51.42 ± 19.49	56.33 ± 22.40	43.15 ± 20.82	.084
ASES	39.97 ± 17.73	48.12 ± 18.69	46.49 ± 18.80	.225
Tampa scale kinesiophobia 11 score	24.46 ± 5.134	26.50 ± 5.89	26.46 ± 5.70	.269
State-trait anger expression inventory score	14.82 ± 2.99	15.39 ± 2.29	15.21 ± 2.81	.753
Fear avoidance beliefs questionnaire work subscale	14.36 ± 11.08	17.82 ± 9.56	19.79 ± 9.89	.101
Pain anxiety symptom scale 20	31.69 ± 15.72	38.75 ± 16.27	35.80 ± 14.44	.274
State trait anxiety inventory	36.54 ± 8.22	38.21 ± 6.25	37.11 ± 6.74	.747
Fear avoidance beliefs questionnaire physical activity subscale	17.94 ± 3.45	17.53 ± 3.85	17.65 ± 3.97	.921
Patient Health Questionnaire - 9	5.67 ± 4.39	7.03 ± 4.30	5.72 ± 4.07	.518
Pain catastrophizing scale	16.59 ± 11.17	21.75 ± 11.43	18.29 ± 10.13	.285
Pain self efficacy questionnaire	33.93 ± 11.91	30.53 ± 12.46	31.58 ± 10.42	.548
Self-efficacy for rehabilitation	89.52 ± 24.43	90.32 ± 25.32	90.77 ± 18.62	.974
Chronic pain acceptance	60.34 ± 16.90	54.19 ± 18.12	56.25 ± 14.97	.395

ASES, American Shoulder and Elbow Surgeons score; Pain, numeric rating scale for shoulder pain; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.
Duration of symptoms (0 = <1–3 mo, 1 = >3 mo).

not appear to be a determinant of RCT severity in patients undergoing rotator cuff repair.

However, when evaluating the association between pain associated psychological distress and shoulder pain and function, while adjusting for RCT severity, we found multiple significant associations (Table III). Within the negative mood domain, trait anxiety was significantly associated with the ASES score (standardized beta [Beta] −0.233, P = .033). Within the negative coping domain, both fear avoidance dimensions were significantly associated with all three PROs assessed: fear-avoidance behavior for physical activity (ASES Beta −0.592, P < .001; SANE Beta −0.351, P = .001; VAS 0.357, P < .001) and work (ASES Beta −0.442, P < .001; SANE Beta −0.270, P = .016; VAS 0.274, P = .015). Furthermore, pain catastrophizing, kinesiophobia, and pain anxiety were all significantly associated with VAS and ASES scores. The moderate strength correlation (Beta −0.592) found between fear avoidance beliefs for physical activity and ASES score was the only moderate strength correlation appreciated in our analysis, where all other significant associations only met thresholds for very weak or weak correlations. Similarly, within the positive affect and coping domain, all three dimensions

of pain self-efficacy (Beta 0.293, P = .007; Beta −0.308, P = .003), self-efficacy for rehabilitation (Beta 0.349, P = .001; Beta −0.348, P = .003), and chronic pain acceptance (Beta 0.234, P = .033; Beta −0.271, P = .022) were shown to be significantly associated with VAS pain and ASES clinical outcome scores (Table III). These findings emphasize significant correlations between specific dimensions of preoperative psychological distress and preoperative pain and function when adjusting for rotator cuff severity.

Discussion

A variety of psychological distress factors have been demonstrated in patients presenting for evaluation for RCT.[15] Many patient psychological screening tools have been developed for use in orthopedic surgery and rehabilitation, but there lacks consensus on which tools can optimally predict patient outcome after rotator cuff repair. Moreover, many of these questionnaires are long and time consuming, possibly becoming burdensome for routine usage. The OSPRO uses 10 items to concisely provide accurate score estimates for 11 commonly used patient psychological distress

Table III
Linear regression analysis results demonstrating the association between psychological distress and shoulder pain and function, adjusted for rotator cuff tendon tear severity.

	VAS pain[a]	SANE score	ASES score
	Adjusted B (95% CI) *P* value, standardized beta	Adjusted B (95% CI) *P* value, standardized beta	Adjusted B (95% CI) *P* value, standardized beta
OSPRO negative mood			
Depression	0.091 (−0.038 to 0.220) *P* = .163 (SB 0.154)	−0.486 (−1.563 to 0.591) *P* = .372 (SB −0.099)	−0.874 (−1.824 to 0.077) *P* = .071 (SB −0.198)
Trait anxiety	0.064 (−0.010 to 0.138) *P* = .091 (SB 0.187)	−0.333 (−0.962 to 0.297) *P* = .296 (SB −0.116)	**−0.599 (−1.148 to −0.050) *P* = .033 (SB −0.233)**
Trait anger	0.093 (−0.102 to 0.289) *P* = .345 (SB 0.105)	−1.181 (−2.825 to 0.462) (SB −0.157)	−0.567 (−2.022 to 0.889) *P* = .441 (SB −0.085)
OSPRO negative coping			
Fear-avoidance beliefs for physical activity	**0.249 (0.105 to 0.393) *P* < .001 (SB 0.357)**	**−2.008 (−3.185 to −0.831) *P* = .001 (SB −0.351)**	**−2.932 (−3.804 to −2.060) *P* < .001 (SB −0.592)**
Fear-avoidance beliefs for work	**0.065 (0.013 to 0.116) *P* = .015 (SB 0.274)**	**−0.539 (−0.975 to −0.103) *P* = .016 (SB −0.270)**	**−0.743 (−1.103 to −0.382) *P* < .001 (SB −0.422)**
Pain catastrophizing	**0.059 (0.010 to 0.109) *P* = .019 (SB 0.257)**	−0.135 (−0.564 to 0.295) *P* = .535 (SB −0.176)	**−0.538 (−0.891 to −0.186) *P* = .003 (SB −0.318)**
Kinesiophobia	**0.139 (0.042 to 0.236) *P* = .006 (SB 0.307)**	−0.627 (−1.462 to 0.208) *P* = .139 (SB −0.165)	**−1.259 (−1.942 to −0.576) *P* < .001 (SB −0.379)**
Pain anxiety	**0.052 (0.018 to 0.087) *P* = .003 (SB 0.321)**	−0.195 (−0.495 to 0.106) *P* = .201 (SB −0.142)	**−0.451 (−0.696 to −0.207) *P* < .001 (SB −0.378)**
OSPRO positive affect and coping			
Pain self-efficacy	**−0.062 (−0.107 to −0.017) *P* = .008 (SB −0.308)**	0.289 (−0.110 to 0.687) *P* = .153 (SB 0.158)	**0.474 (0.134 to 0.815) *P* = .007 (SB 0.293)**
Self-efficacy for rehabilitation	**−0.036 (−0.059 to −0.013) *P* = .003 (SB −0.348)**	0.198 (−0.005 to 0.401) *P* = .056 (SB 0.210)	**0.289 (0.119 to 0.459) *P* = .001 (SB 0.349)**
Chronic pain acceptance	**−0.037 (−0.069 to −0.005) *P* = .022 (SB −0.271)**	0.148 (−0.130 to 0.427) *P* = .292 (SB 0.117)	**0.262 (0.022 to 0.503) *P* = .033 (SB 0.234)**

OSPRO, optimal screening for prediction of referral and outcome assessment tool; *SB*, Standardized Beta coefficients; *VAS*, visual analog scale; *SANE*, single assessment numeric evaluation; *ASES*, American Shoulder and Elbow Surgeons.

[a] In addition to adjusting for rotator cuff tendon tear severity, ethnicity was.

questionnaires. This study sought to characterize the prevalence of preoperative psychological distress scores using the OSPRO in patients who underwent rotator cuff repair. This is significant because it is universally known that mental health can impact shoulder pain and function, potentially even more so than RCT size, as is explored in this study.

This work compared the severity of RCTs that were stratified into 3 tiers: 1) small to medium, 2) medium to large, and 3) large to massive. These tiers were utilized as groupings in analysis involving differing dimensions within the OSPRO to demarcate patterns of psychological distress seen in patients undergoing surgical intervention for RCT. We hypothesized that larger RCTs would have a less significant impact on shoulder pain and function than preoperative measures of mental health and psychological distress. In line with our hypothesis, we found preoperative psychological distress to be a stronger predictor of poor shoulder function and pain than RCT severity in patients undergoing arthroscopic rotator cuff repairs. There were neither significant differences in patient-reported outcomes nor in any of the 11 domains of the OSPRO with regards to increasing RCT size. This heavily suggests that increasing rotator cuff severity does not influence the degree of psychological distress a patient endures during and after rotator cuff repair. Thus, we argue for the need of increased cognizance on the import mental health plays in rotator cuff repair rehabilitation and the need for screening for multiple dimensions of pain-associated psychological distress in RCT populations to identify patients who may benefit from multimodal therapeutic intervention.

We demonstrate high rates of psychological distress, as tabulated by the OSPRO questionnaire in patients seeking care for RCTs. It is possible that current inadequate recognition of patient-specific psychological distress could be contributing to high rates of increased postoperative opioid utilization[14,24] as well as subsequent poor postoperative functional improvement and pain

resolution. Our data corroborates earlier work demonstrating high rates of psychological distress in patients with RCT. We demonstrated that patients seeking arthroscopic repair of RCTs appear to have elements of negative mood (ie, anger, depressed, and anxiety) or low confidence in rehabilitation (lacking belief in conservative measures) at baseline. Therefore, in this select sample of patients, those who are more likely to lack confidence in rehab approaches and/or have negative mood overlays at baseline may perform worse on functional assessments and/or report greater levels of pain during their clinical course. In summary, it is evident from the results of our study and the existing literature that preoperative psychological distress in individuals with RCTs can influence patient-perceived shoulder pain and function to a greater extent than the tear severity. However, given that this was a cross-sectional study, the eventual impact of these findings on postoperative outcomes has yet to be fully elucidated.

In concordance with our hypothesis, our results demonstrate baseline psychological distress correlates with patient shoulder pain and function more than rotator cuff severity. This data adds to a mounting body of evidence, which suggests that RCT size and severity does not correlate with symptoms such as pain and functional limitation. Park et al identified several factors as being predictive of increased shoulder pain at the time of presentation for RCT: young age, male sex, and the presence of diabetes mellitus.[13] Similarly, Simon et al tested an index that accounted for RCT severity and concomitant surgical procedures and found that neither was predictive of 6- or 12-month pain and disability outcomes following shoulder arthroscopy.[19] Notably, however, these authors report that measurements of RCT characteristics, including tear size, muscle atrophy, and the number of torn tendons, did not correlate with shoulder pain.[13] The mechanism behind this seemingly contradictory finding is unknown. Intuitively, greater RCT size and severity would appear to correlate with increased pain and

disability. It is possible that individuals with chronic, severe RCTs with significant fatty atrophy, retraction, and multiple tendon involvement may develop compensatory mechanisms to improve their capacity to complete their activities of daily living pain free. Future work should aim to explore this finding and evaluate for protective psychosocial factors present in those who seek clinical evaluation only after their RCT has progressed to the point of particular severity.

Several limitations are present in this study. First, this study is cross-sectional in nature. Thus, we forfeit the ability to assess postoperative outcomes, and to correlate the presence of higher measures of mental distress in an individual with adverse clinical outcomes after rotator cuff repair. We hope to expand upon this early work by collecting postoperative PROs and assessing for correlation between the OSPRO and functional outcome, as well as outcomes related to factors such as time to return to work and duration of opioid use after surgery. Second, we recognize that our findings are not generalizable to the full sampling of patients with rotator cuff pathology, as we only included individuals who had presented for surgical treatment of RCTs in our analysis. Thus, we cannot extrapolate to the general population of patients with rotator cuff pathology, many of whom will have significant findings on magnetic resonance imaging and clinical exam, but who will never present to an orthopedic shoulder specialist for evaluation. Still, our results hold merit for the practicing clinician in understanding the characteristics of not the standard patient with rotator cuff pathology, but rather the standard patient who presents for surgical management of rotator cuff pathology. Lastly, our patients fill out the OSPRO questionnaire in clinic prior to evaluation by an orthopedic shoulder specialist. This methodology ensures maximal participation in capturing OSPRO scores but may potentially bias response items given the proximity to subspecialty evaluation. For example, patients may rate their psychological distress as higher in anticipation of a discussion with their physician about their shoulder. While we recognize this potential for bias, we argue that a patient's state of psychological well-being at the time of initial evaluation may provide a reasonable estimate of their overall state through the rotator cuff repair process, given the arduous process of surgery, recovery, rehabilitation, and potentially long duration of weight bearing restrictions. Future research should aim to better characterize the temporal nature of fluctuations in psychological well-being throughout the surgical process to further elucidate at which time points a patient is most likely to require additional support from a psychological standpoint.

While it is important to fully understand the challenges presented by high levels of baseline psychological distress in patients presenting with RCT, it is imperative to prevent stigmatization of these patients. Categorization by psychological and mental health characteristics has been shown to impart feelings of guilt and shame in patients.[1] Furthermore, failure to identify "at risk" patients may cause physicians to disregard the psychological and emotional aspects of health, which are imperative to the success of each patient, regardless of the presence or absence of psychological distress. We encourage the use of nonstigmatizing language and careful consideration of a patient's well-being at each office visit.[8]

Conclusion

Baseline preoperative psychological distress is very prevalent in patients with RCTs who seek arthroscopic repair, as identified by the OSPRO. This baseline psychological distress has been shown to be a stronger predictor of patient-perceived shoulder pain and function. In concordance with a growing body of evidence in orthopedics, which fails to correlate functional symptoms and pain to RCT size and severity, we demonstrate that patients, who exhibit

higher scores on the domains of negative mood and negative coping, and lower scores on positive affect and coping, are associated with increased shoulder pain and more pronounced functional limitations. Future work should aim to confirm these findings and better characterize the influence of preoperative mental health scores for postoperative RCT cohort outcomes.

Disclaimers:

References

1. Ahmedani BK. Mental health stigma: society, individuals, and the profession. J Soc Work Values Ethics 2011;8:41-416.
2. Block AR, Ohnmeiss DD, Guyer RD, Rashbaum RF, Hochschuler SH. The use of presurgical psychological screening to predict the outcome of spine surgery. Spine J 2001;1:274-82.
3. Boonstra AM, Schiphorst Preuper HR, Reneman MF, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. Int J Rehabil Res 2008;31:165-9. https://doi.org/10.1097/MRR.0b013e3282fc0f93.
4. Carragee EJ, Alamin TF, Miller JL, Carragee JM. Discographic, MRI and psychosocial determinants of low back pain disability and remission: a prospective study in subjects with benign persistent back pain. Spine J 2005;5:24-35. https://doi.org/10.1016/j.spinee.2004.05.250.
5. Gatchel RJ, Polatin PB, Mayer TG. The dominant role of psychosocial risk factors in the development of chronic low back pain disability. Spine (Phila Pa 1976) 1995;20:2702-9.
6. George SZ, Beneciuk JM, Bialosky JE, Lentz TA, Zeppieri G Jr, Pei Q, et al. Development of a review-of-systems screening tool for orthopaedic physical therapists: results from the optimal screening for prediction of referral and outcome (OSPRO) cohort. J Orthop Sports Phys Ther 2015;45:512-26. https://doi.org/10.2519/jospt.2015.5900.
7. George SZ, Beneciuk JM, Lentz TA, Wu SS, Dai Y, Bialosky JE, et al. Optimal screening for prediction of referral and outcome (OSPRO) for musculoskeletal pain conditions: results from the Validation cohort. J Orthop Sports Phys Ther 2018;48:460-75. https://doi.org/10.2519/jospt.2018.7811.
8. Hantzi A, Anagnostopoulos F, Alexiou E. Attitudes towards seeking psychological help: an integrative model based on contact, essentialist beliefs about mental illness, and stigma. J Clin Psychol Med Settings 2019;26:142-57. https://doi.org/10.1007/s10880-018-9573-8.
9. Lawrence RL, Moutzouros V, Bey MJ. Asymptomatic rotator cuff tears. JBJS Rev 2019;7:e9. https://doi.org/10.2106/jbjs.Rvw.18.00149.
10. Lentz TA, Beneciuk JM, Bialosky JE, Zeppieri G Jr, Dai Y, Wu SS, et al. Development of a yellow flag assessment tool for orthopaedic physical therapists: results from the optimal screening for prediction of referral and outcome (OSPRO) cohort. J Orthop Sports Phys Ther 2016;46:327-43. https://doi.org/10.2519/jospt.2016.6487.
11. Lentz TA, Beneciuk JM, George SZ. Prediction of healthcare utilization following an episode of physical therapy for musculoskeletal pain. BMC Health Serv Res 2018;18:648. https://doi.org/10.1186/s12913-018-3470-6.
12. Lentz TA, George SZ, Manickas-Hill O, Malay MR, O'Donnell J, Jayakumar P, et al. What general and pain-associated psychological distress phenotypes exist among patients with hip and knee osteoarthritis? Clin Orthop Relat Res 2020;478:2768-83. https://doi.org/10.1097/corr.0000000000001520.
13. Park I, Lee H-J, Kim S-K, Park M-S, Kim Y-S. Factors related to preoperative shoulder pain in patients with atraumatic painful rotator cuff tears. Clin Shoulder Elb 2019;22:128-34. https://doi.org/10.5397/cise.2019.22.3.128.
14. Potter MQ, Sun GS, Fraser JA, Beckmann JT, Swenson JD, Maak TG, et al. Psychological distress in hip arthroscopy patients affects postoperative pain control. Arthroscopy 2014;30:195-201. https://doi.org/10.1016/j.arthro.2013.11.010.
15. Potter MQ, Wylie JD, Greis PE, Burks RT, Tashjian RZ. Psychological distress negatively affects self-assessment of shoulder function in patients with rotator cuff tears. Clin Orthop Relat Res 2014;472:3926-32. https://doi.org/10.1007/s11999-014-3833-1.
16. Reilly P, Macleod I, Macfarlane R, Windley J, Emery RJ. Dead men and radiologists don't lie: a review of cadaveric and radiological studies of rotator cuff tear prevalence. Ann R Coll Surgeons Engl 2006;88:116-21. https://doi.org/10.1308/003588406x94968.
17. Roh YH, Lee BK, Noh JH, Oh JH, Gong HS, Baek GH. Effect of depressive symptoms on perceived disability in patients with chronic shoulder pain. Arch Orthop Trauma Surg 2012;132:1251-7. https://doi.org/10.1007/s00402-012-1545-0.
18. Roh YH, Noh JH, Oh JH, Baek GH, Gong HS. To what degree do shoulder outcome instruments reflect patients' psychologic distress? Clin Orthop Relat Res 2012;470:3470-7. https://doi.org/10.1007/s11999-012-2503-4.

19. Simon CB, Coronado RA, Greenfield WH 3rd, Valencia C, Wright TW, Moser MW, et al. Predicting pain and disability after shoulder arthroscopy: rotator cuff tear severity and concomitant arthroscopic procedures. Clin J Pain 2016;32:404-10. https://doi.org/10.1097/ajp.0000000000000267.
20. Tempelhof S, Rupp S, Seil R. Age-related prevalence of rotator cuff tears in asymptomatic shoulders. J Shoulder Elbow Surg 1999;8:296-9.
21. Teunis T, Lubberts B, Reilly BT, Ring D. A systematic review and pooled analysis of the prevalence of rotator cuff disease with increasing age. J Shoulder Elbow Surg 2014;23:1913-21. https://doi.org/10.1016/j.jse.2014.08.001.
22. Tokish JM, Alexander TC, Kissenberth MJ, Hawkins RJ. Pseudoparalysis: a systematic review of term definitions, treatment approaches, and outcomes of management techniques. J Shoulder Elbow Surg 2017;26:e177-87. https://doi.org/10.1016/j.jse.2017.02.024.
23. Trief PM, Grant W, Fredrickson B. A prospective study of psychological predictors of lumbar surgery outcome. Spine (Phila Pa 1976) 2000;25:2616-21.
24. Vincent HK, Horodyski M, Vincent KR, Brisbane ST, Sadasivan KK. Psychological distress after orthopedic trauma: prevalence in patients and implications for rehabilitation. PM R 2015;7:978-89. https://doi.org/10.1016/j.pmrj.2015.03.007.
25. Vranceanu AM, Jupiter JB, Mudgal CS, Ring D. Predictors of pain intensity and disability after minor hand surgery. J Hand Surg Am 2010;35:956-60. https://doi.org/10.1016/j.jhsa.2010.02.001.
26. Wickman JR, Lau BC, Scribani MB, Wittstein JR. Single assessment numeric evaluation (SANE) correlates with American Shoulder and Elbow Surgeons score and Western Ontario Rotator Cuff index in patients undergoing arthroscopic rotator cuff repair. J Shoulder Elbow Surg 2020;29:363-9. https://doi.org/10.1016/j.jse.2019.07.013.
27. Yamamoto A, Takagishi K, Kobayashi T, Shitara H, Osawa T. Factors involved in the presence of symptoms associated with rotator cuff tears: a comparison of asymptomatic and symptomatic rotator cuff tears in the general population. J Shoulder Elbow Surg 2011;20:1133-7. https://doi.org/10.1016/j.jse.2011.01.011.