Original Article

Pain-Associated Psychological Distress Is of High Prevalence in Patients With Hip Pain: Characterizing Psychological Distress and Phenotypes

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Purpose: To identify common pain-related psychological factors among patients seeking care for athletic hip pain, as well as characterize psychological distress phenotypes and compare hip-specific quality-of-life measures across those phenotypes. **Methods:** A total of 721 patients were recruited from hip preservation clinics. The Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool (OSPRO-YF) was used to identify the presence or absence of 11 different pain-associated psychological distress characteristics (yellow flags), while the International Hip Outcome Tool—12 (iHOT-12) was used to assess hip-related quality of life. Latent class analysis identified patient subgroups (phenotypes) based on naturally occurring combinations of distress characteristics. An analysis of variance was used to compare demographics, number of yellow flags, and iHOT-12 scores across phenotypes. **Results:** The median (interquartile range) number of yellow flags was 6 (3-9), with 13.5% of the sample reporting 11 yellow flags. Latent class analysis ($L^2 = 543.3$, classification errors = 0.082) resulted in 4 phenotypes: high distress (n = 299, 41.5%), low distress (n = 172, 23.9%), low self-efficacy and acceptance (n = 74, 10.3%), and negative pain coping (n = 276, 24.4%). Significant differences in mean yellow flags existed between all phenotypes except low self-efficacy and negative pain coping. There were no differences in demographics between phenotypes. The high distress class had the lowest mean iHOT-12 score (mean [SD], 23.5 [17.6]), with significant differences found between each phenotypic class. **Conclusions:** There was a high prevalence of pain-associated psychological distress in patients presenting to tertiary hip arthroscopy clinics with hip pain. Furthermore, hip quality-of-life outcome scores were uniformly lower in patients with higher levels of psychological distress. **Level of Evidence:** Level III, retrospective cohort study.

There are a multitude of causes of hip pain seen by orthopaedic physicians. These include but are not limited to intra-articular injury, nerve injuries, osseous deformities, and muscular weakness and tendonopathies.[1] Medical history, physical examination, and imaging are all useful tools in elucidating the correct diagnosis and subsequent treatment pathway. Understanding the impact of hip pain on the patient's quality of life to inform management is especially important. Yet despite proper assessment and management of these patients, pain and disability may persist.[2-4] This suggests that additional factors aside from biomedical causes contribute to pain and disability and that further exploration and attention to discerning these factors is required to effectively treat musculoskeletal conditions.

Previously published literature suggests that pain is a multifaceted phenomenon influenced by changes in anatomy, central and peripheral pain processing, and psychological and cognitive factors.[5-7] Psychological factors such as kinesophobia and pain catastrophizing have been found to influence orthopaedic patients' pain; furthermore, psychological distress is known to influence treatment outcomes for osteoarthritis, knee pain, and chronic low back pain.[8-15] Moreover, this psychological distress has been found to be associated with increased utilization of health care resources.[16-23]

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Understanding the psychological distress experienced by patients with musculoskeletal pain has been shown to provide greater prognostic information on clinical outcomes, and addressing this distress has shown encouraging results in this population.[24-31]

Despite the relation of pain-associated psychological distress and musculoskeletal pain, these factors are often underrecognized and undertreated in orthopaedic care delivery. Historically, routine orthopaedic assessment has focused on the biomedical model of care and excluded psychological assessment because comprehensive assessment of psychological needs is difficult and places significant burden on providers and patients.[32-34] The biopsychosocial model for pain, popularized by John Loeser,[35] encourages providers to view the patient as a whole person and consider that more than just medical and surgical factors contribute to the patient's pain experience. The availability of new tools (such as the Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool, or OSPRO-YF) that efficiently assess a wide spectrum of psychological constructs has created opportunities to better characterize the heterogeneity of pain-related psychological distress in orthopaedic populations.[36] Using this tool, providers can effectively practice the biopsychosocial model approach to pain and use psychological phenotyping to deliver more comprehensive care.

Phenotyping, or the practice of identifying similar observable traits in a population and creating subgroups based on these traits, has been used effectively in the past to characterize psychological distress.[15,37-39] Through stratification of heterogenous populations of patients with a similar pathology by psychological characteristics, scalable treatment pathways can be created for specific groups of patients who share not only similar pathology but also similar psychosocial profiles.[10] For example, patients with high levels of kinesophobia may be phenotyped into a group that providers assign a different rehabilitation protocol that focuses on overcoming the cognitive burden of returning to normal function as well as spending extra time on goal-specific activity training. This manner of phenotyping orthopaedic patients has been effectively done in different subsets of patients with chronic musculoskeletal pain[10,15,40-45] but not in populations with hip pain.

The purpose of this study was to identify common pain-related psychological factors among patients seeking care for athletic hip pain, as well as characterize psychological distress phenotypes and compare hip-specific quality-of-life measures across those phenotypes. We hypothesized that most patients would have some degree of pain-associated psychological distress and that it would present in a manner that would allow us to classify patients into discernible groups based on these characteristics.

Methods

Study Design, Setting, and Participants

A retrospective, cross-sectional design was used to analyze patients seen by 3 orthopaedic surgeons who specialize in hip pathology (B.D.L., S.O., and R.C.M.) at a tertiary care academic medical center between January 13, 2020, and October 27, 2021. This sample included patients referred from other health care providers who determined that a hip arthroscopist was best equipped to treat their pathology, as well as patients who were self-referred. It should be noted that 2 surgeons' practices (S.O. and B.D.L.) include patients with both nonarthritic and arthritic hip disease due to this self-referral option. Patients were only included in the study if they had complete scores for both the OSPRO-YF and the International Hip Outcome Tool—12 (iHOT-12) because this was required for the phenotype analysis. All patients between the ages of 18 and 65 years who were seen during the study time period were included in the initial data review. All data collected and actions associated with this study were carried out in accordance with the ethical standards established in the 1964 Declaration of Helsinki and relevant regulations of the US Health Insurance Portability and Accountability Act.

Description of Experiment, Treatment, or Surgery Variables, Outcome Measures, Data Sources, and Bias

Demographic information including sex, age, race, ethnicity, and employment status was collected at each patient's initial visit with a provider. Self-reported measures of pain-associated psychological distress and hip-related quality of life were also collected at these initial visits.[36,46]

Pain-Associated Psychological Distress

Pain-associated psychological distress was measured with the 10-item OSPRO-YF questionnaire. This multidimensional assessment tool generates estimates for what patients would score on 11 different commonly used questionnaires for pain-related psychological distress (e.g., the Fear Avoidance Beliefs Questionnaire or the Pain Catastrophizing Scale [PCS]). The benefit of this tool is that it can provide a comprehensive assessment of psychological distress in populations with musculoskeletal pain but in a fraction of the time it would take to administer a full battery of 11 questionnaires. The 11 psychological constructs measured by the OSPRO-YF can be categorized into 3 domains (corresponding constructs in parentheses): negative mood (depression, trait anxiety, and trait anger), negative coping (fear avoidance for work, fear avoidance for physical activity, pain catastrophizing, kinesophobia, and pain anxiety), and positive affect/

coping (pain self-efficacy, self-efficacy for rehabilitation, and pain acceptance).[36,47-55] For each of the 11 constructs, the OSPRO-YF also identifies the presence or absence of a "yellow flag," defined as questionnaire score estimates in the 75th percentile or higher for negative domain constructs and 25th percentile or worse (lower) for positive affect/coping constructs compared to population distributions. For example, if the 75th percentile threshold for the PCS score estimate was 20, then patients with score estimates 20 and above would be assigned a "yellow flag" for pain catastrophizing. As such, patients could have a minimum of 0 yellow flags or a maximum of 11 yellow flags. Prior studies have established good reliability and validity of the OSPRO-YF in populations with musculoskeletal pain conditions.[36] These yellow flags could thus serve as a valuable tool to further stratify patients with similar biomedical pathology into subgroups defined by similar psychological profiles.

Hip-Related Quality of Life

Hip joint–related quality of life was assessed with the iHOT-12. This tool was developed from the original iHOT-33, a quality-of-life patient-reported outcome measure that has shown face, content, and construct validity while also being reliable and highly responsive to clinical changes in patients.[46,56] The items in this tool assess 4 domains, including symptoms and functional limitations, sports and recreational activities, job-related concerns, and social, emotional, and lifestyle considerations. The iHOT-12 assesses hip–related quality of life through the same domains but with only 12 items to provide greater ease and practicality for use in the clinical setting. Despite being one-third of the length of the iHOT-33, the iHOT-12 was found to capture 95.9% of the variation of the iHOT-33 and was thus deemed acceptable for use in this study.[46]

Statistical Analysis

Statistical analyses were completed in IBM SPSS Statistics for Windows, version 27.0 (IBM Corp) and Latent GOLD software version 6.0 (Statistical Innovations). To address the first aim, frequencies of yellow flags for each construct were calculated from OSPRO-YF scores. These yellow flags were then reported by domain.

To address the second aim, a latent class analysis was used to derive phenotypes based on the presence or absence of the 11 possible yellow flag indicators.[57] Model fit of several different numbers of phenotypic classes was assessed using the model-fit likelihood ratio chi-square statistic (L^2), which compares the similarity between model-based frequencies and observed frequencies.[58] The Bayesian information criterion and Akaike information criterion were also used to gauge model fit, with lower values indicating closer model representation of observed frequency.[58] Additional measures used to assess the most representative model included the proportion of classification errors, class size, and interpretability of classes (clinical relevance of phenotype).[59-62] After selection of the latent class model, patients were assigned to groups according to highest posterior probability estimates. Demographic variables, yellow flags, and iHOT-12 scores were compared across each unique phenotypic group via 1-

Table 1. Participant Demographics

Characteristic	Value
Age, mean ± SD, y	39.2 ± 13.1
Sex	
Male	272 (37.7)
Female	449 (62.3)
Race	
Caucasian	560 (77.7)
Black or African American	95 (13.2)
Asian	19 (2.6)
American Indian or Alaskan Native	3 (0.4)
Native Hawaiian or Other Pacific Islander	1 (0.1)
Other	7 (1.0)
Not reported/declined	36 (5.0)
Ethnicity	
Hispanic/Latino	36 (4.4)
Not Hispanic/Latino	653 (90.6)
Employment	
Full-time	332 (46.0)
Part-time	22 (3.1)
Student—full-time	52 (7.2)
Student—part-time	2 (0.3)
Self-employed	35 (4.9)
Disabled	41 (5.7)
Not employed	82 (11.4)
Retired	34 (4.7)
Unknown	44 (6.1)
On active military duty	76 (10.5)

NOTE. Values are presented as number (%) unless otherwise indicated.

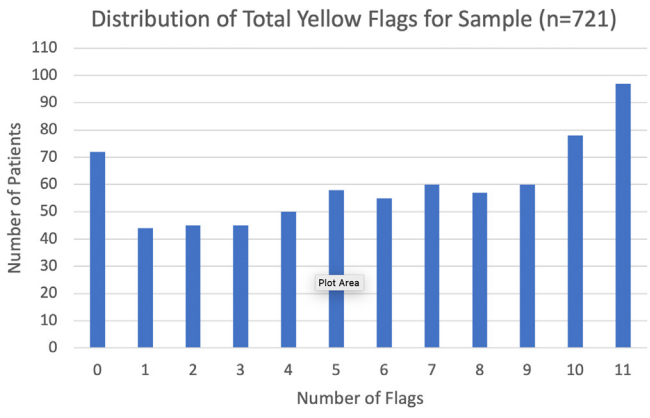

Fig 1. Total distribution of yellow flags as determined by the Optimal Screening for Prediction of Referral and Outcome–Yellow Flag Assessment Tool across our cohort.

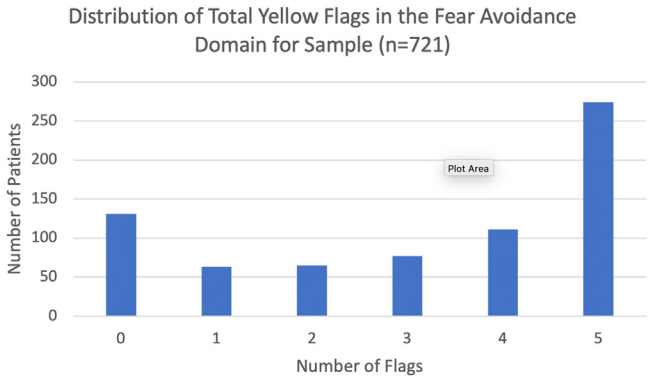

Fig 2. The distribution of total yellow flags as determined by the Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool in the fear avoidance domain across our cohort.

way analysis of variance with least significant difference post hoc comparisons.

Results

A total of 1,348 patients were initially identified. After excluding those without complete data on the questionnaires used for phenotyping and hip-specific quality of life, our study population comprised 721 patients (53.5% of all patients seen), 449 (62.3%) of whom were female. Participants had a mean (SD) age of 39.2 (13.1) years and were predominantly Caucasian/White (77.7%), not Hispanic/Latino (90.6%), and employed full-time (46.0%). The full distribution of demographics can be seen in Table 1.

Prevalence and Type of Pain-Associated Psychological Distress

With regard to yellow flag distribution, the range was from 0 to 11, with approximately 24.3% having 10 or 11 yellow flags (Fig 1). Data were then stratified by domain. In the fear avoidance domain, the largest proportion of patients (38.0%) had 5 yellow flags (out of a maximum of 5) (Fig 2). In the positive affect/coping domain, the highest proportion of patients (42.0%) had 3 yellow flags (out of a possible 3) (Fig 3). Yellow flags were less common in the negative mood domain, where the largest proportion (42.7%) had 0 yellow flags (out of a possible 3) and only 22.1% had 3 yellow flags (Fig 4). For individual constructs, the highest proportion of yellow flags were for kinesophobia (70.6% of patients), pain anxiety (65.3%), pain acceptance (64.4%), and pain self-efficacy (63.0%) (Fig 5).

Pain-Related Psychological Distress Phenotypes

Statistical criteria and empirical evaluation of potential latent class models indicated a 4-class model best fit to our data based on a low classification error rate (0.082), class size (all greater than 10%), and grouping of constructs consistent with established biopsychosocial models. Phenotypes were characterized on their predominant psychological profile, yielding classes defined as (percentage of sample) high distress (41.5%), negative pain coping (24.4%), low distress (23.9%), and low self-efficacy and acceptance (10.3%). The likelihood of a yellow flag in a specific construct for each class is listed in Table 2. The high distress class had the lowest mean (SD) iHOT-12 score of 23.5 (17.6), while the low distress class had the largest (47.2 [21.3]) (Table 3). There were significant differences in iHOT-12 scores found between each class with the exception of between the low distress and low self-efficacy and acceptance class (Fig 6). The high distress class also had the greatest mean number of yellow flags, with significant differences in number of yellow flags between each group class (Fig 7). There was no significant difference in mean age among the phenotypes.

Discussion

Our most important finding was that nearly a quarter of the hip pain population studied had 10 of 11 yellow flags, while over half of the cohort exhibited at least 6 yellow flags. Importantly, iHOT-12 outcome scores were uniformly lower in phenotypes defined by higher or more complex levels of psychological distress. Our results suggest the common biomedical approaches to managing hip pain may alone be insufficient to address the many characteristics that contribute to the pain experience for patients with hip pain.

We found moderate to high levels of distress across many of the patients included in this analysis, which could reflect the chronicity and subacute nature of the hip pain seen in this patient population. Yellow flags were concentrated in the fear avoidance and the positive affect/coping domains, with fewer yellow flags, on average, in the negative mood domain. Similar results were found in other studies; Horn et al.[63] found low

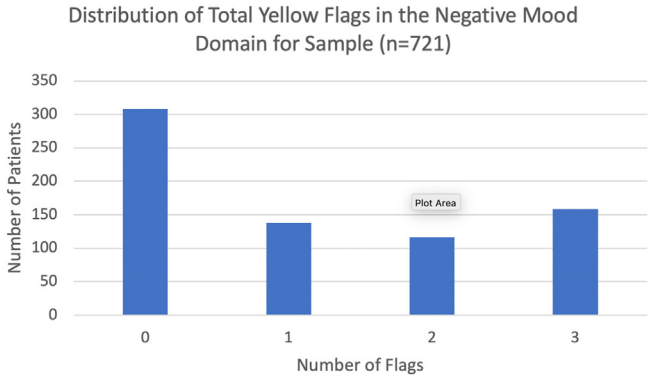

Fig 3. The distribution of total yellow flags in the positive affect/coping domain as determined by the Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool across our cohort.

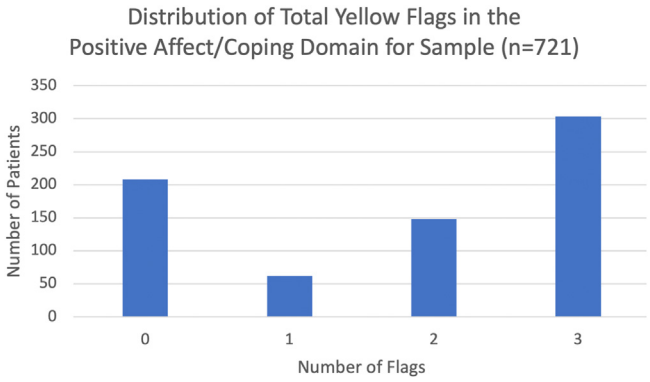

Fig 4. The distribution of total yellow flags in the negative mood domain as determined by the Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool across our cohort.

levels of depression across orthopaedic patients (aligning with negative mood domain) while finding higher levels of pain interference and physical functioning impairment (outcomes often associated with high catastrophizing and fear avoidance). Furthermore, Okafor et al.[64] found lower levels of negative mood and increased levels of fear avoidance and positive affect/coping in their study on patients with rotator cuff tears. Existing literature has found increased adverse outcomes in patients with higher levels of fear avoidance and negative mood, but little data exist on specific psychological interventions used in orthopaedic patients to help reduce pain.[65,66] Maschke et al.[67] enrolled patients with lower extremity and lumbopelvic injuries into a rehabilitation program and measured changes in pain-associated psychological distress. They found a decrease in yellow flags in positive affect/coping and fear avoidance domains but no significant change in the negative mood domain after their rehabilitation program. Collectively, these findings reinforce the distinct nature of the identified psychological domains and support the importance of considering positive affect/coping and fear avoidance beliefs when making treatment decisions in this population.

We identified 4 psychological phenotypes among patients with hip pain: high psychological distress, low psychological distress, low self-efficacy and acceptance, and negative pain coping. Approximately 42% of the sample was defined by a high distress phenotype, which is a significant concern because the presence of psychological distress in patients with athletic hip pain can obfuscate the diagnostic process and may affect response to surgical treatment.[68-71] Identifying these patients is important for surgeons, as these patients may be less likely to satisfactorily resolve their pain from surgery alone.[72] Rather, these patients may benefit from a "prehabilitation" program where they undergo both physical strengthening and psychologically focused interventions for optimized outcomes. Studies have shown these methods to improve functional recovery after surgery, but literature on comprehensive programs in patients with hip pain is lacking.[73-75] Further research is needed to establish effective protocols specific for patients with hip pain who have varying levels of pain-associated psychological distress.

We also evaluated the relation between yellow flags and the iHOT-12, finding lower scores in phenotypes defined by higher or more complex levels of psychological distress. As the iHOT-12 is a patient-reported outcome measure assessing the functional impact of hip pain on patients' daily lives, this relation provided face validation for our phenotypes as we would expect quality of life to be inversely related to pain-associated psychological distress.[14,56,76-80] Recognizing the high prevalence of psychological distress in the hip pain/preservation population is critical because treating distress could lead to better nonoperative and surgical outcomes. In a study on 51 patients with femoroacetabular impingement (FAI) syndrome, Jochimsen et al.[81] reported significantly worse hip function in patients with both high kinesophobia and low self-efficacy. Clapp et al.[82] reported significant improvement in both kinesophobia and pain catastrophizing 1 year after arthroscopy for FAI but found that pain catastrophizing was correlated with failure to achieve a minimal clinically important difference. Our work adds to the literature by underlining the high prevalence of distress and providing direction on which domains may be most important to target.

The relatively young mean age of our patient population was consistent with age distributions found in other athletic hip pain patient studies.[83] Despite the fact that most pathology in these patients was generally caused by chronic processes like repetitive microtrauma, prolonged inflammation, or cartilage degeneration, the relatively young patient demographic may

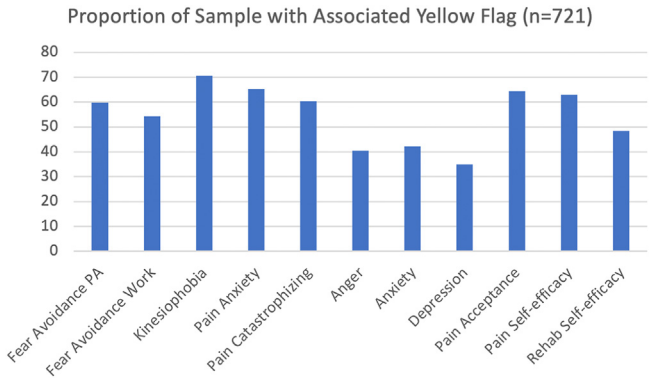

Fig 5. The proportion of our sample with a yellow flag as determined by the Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool in that specific construct.

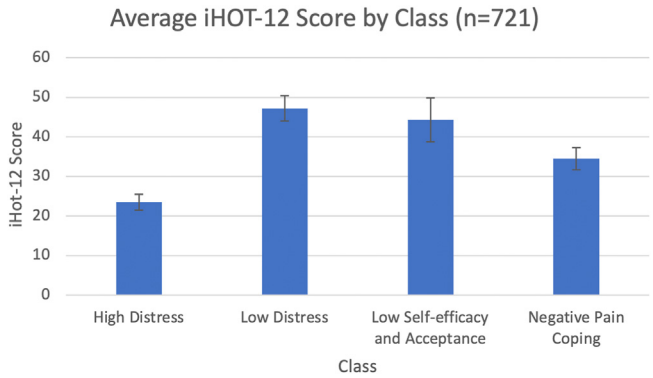

Fig 6. The average International Hip Outcome Tool—12 score across each of the phenotypic classes in our 4-class model. *Error bars are 95% confidence intervals.

influence providers to view these patients as *acutely*—rather than *chronically*—injured and therefore are less suitable candidates for effective chronic pain management strategies. Recently, comprehensive biopsychosocial care models developed for older patients with hip and knee osteoarthritis have generated significant clinical improvements.[84] In this practice, physical therapists provide evidence-based, psychologically informed care for osteoarthritic patients, while also coordinating care with dietitians, behavioral health specialists, and orthopaedic surgeons to provide wholistic care. However, such programs are rarely seen in younger patients or patients with nonarthritic hip pain. Considered together, these data highlight that younger patients with hip pain may benefit from a biopsychosocial treatment approach more commonly seen in patients with chronic pain.

Limitations

This study has several limitations to note. This study was completed at 1 tertiary care academic medical center, and thus the patient population may not be representative of the entire nonarthritic hip pain population. Furthermore, due to the self-referral pathway, some patients had some evidence of degenerative joint disease. However, the nature of the degenerative joint disease in these cases was mild enough that hip arthroscopy was considered a realistic treatment option. Moreover, the distribution of demographic variables in our study was found to be similar to other studies on hip pain.[85,86] Despite the extensive validation of the OSPRO-YF tool, its clinical value is inherently limited to the veracity of patients' self-reporting. Second, the inclusion criteria for the patients in this study were broadly defined as 2 of the surgeons' practices include patients with nonarthritic hip pain as well as those with evidence of degenerative joint disease. This design, however, limits the ability to distinguish between the different musculoskeletal etiologies of hip pain. Furthermore, chronicity of pain was not measured, limiting our ability to determine whether psychological distress varied based on how long a patient had been experiencing pain. Moreover, because this study is cross-sectional, it does not track changes in psychological distress over time, account for day-to-day variability in patient thoughts and emotions that could influence symptom reporting, or determine whether different phenotypes experience different outcomes. Additionally, factors like body mass index, smoking, and sociodemographics were not included in the analysis and could be possible cofounders for psychological distress.

Table 2. Likelihood of Yellow Flag by Construct in Each Phenotype

			High Distress	Negative Pain Coping	Low Distress	Low Self-Efficacy and Acceptance
Cluster Size (%)			41	25	23	11
n	Questionnaire	Construct	299	176	172	74
Negative mood domain	STAXI	Anger	0.59	0.36	0.21	0.23
	STAI	Anxiety	0.76	0.24	0.05	0.37
	PHQ-9	Depression	0.68	0.09	0.06	0.30
Negative coping domain	FABQ-PA	Fear avoidance—physical activity	0.83	0.63	0.26	0.38
	FABQ-W	Fear avoidance—work	0.87	0.50	0.15	0.27
	PASS	Pain anxiety	1.00	0.94	0.01	0.09
	TSK-11	Kinesiophobia	0.99	0.94	0.15	0.30
	PCS	Pain catastrophizing	0.96	0.74	0.06	0.10
Positive affect coping domain	CPAQ	Pain acceptance	0.98	0.58	0.09	0.72
	PSEQ	Pain self-efficacy	1.00	0.48	0.06	0.82
	SER	Rehabilitation self-efficacy	0.86	0.12	0.09	0.77

NOTE. Each score represents the probability of a patient in the specific phenotypic class having a yellow flag from that psychological questionnaire. For example, the probability of a patient in the low distress class having a yellow flag in the Patient Health Questionnaire (negative mood domain) is 0.06.

CPAQ, Chronic Pain Acceptance Questionnaire; FABQ-PA, Fear Avoidance Beliefs Questionnaire Physical Activity Subscale; FABQ-W, Fear Avoidance Beliefs Questionnaire Work Subscale; PASS, Pain Anxiety Symptoms Scale; PCS, Pain Catastrophizing Scale; PHQ-9, Patient Health Questionnaire 9; PSEQ, Pain Self-Efficacy Questionnaire; SER, Self-Efficacy for Rehabilitation; STAI, State-Trait Anxiety Inventory; STAXI, State-Trait Anger Expression Inventory; TSK-11, Tampa Scale of Kinesophobia.

Table 3. Phenotypic Class Characteristics From the 4-Class Model

						95% Confidence Interval for Mean			
		N	Mean	SD	SE	Lower Bound	Upper Bound	Minimum	Maximum
Age	High distress	299	39.28	13.33	0.77	37.76	40.79	18	91
	Negative pain coping	176	39.27	12.64	0.95	37.39	41.15	18	76
	Low distress	172	39.50	12.75	0.97	37.58	41.42	18	72
	Low self-efficacy and acceptance	74	39.23	13.95	1.62	35.05	41.52	18	76
Total yellow flags (# out of 11)	High distress	299	9.55	1.39	0.08	9.39	9.71	5	11
	Negative pain coping	176	5.49	1.70	0.13	5.24	5.74	2	9
	Low distress	172	1.17	1.36	0.10	0.97	1.38	0	6
	Low self-efficacy and acceptance	74	4.43	1.55	0.18	4.07	4.79	2	8
IHOT-12 total mean score	High distress	299	23.51	17.63	1.02	21.51	25.52	0.00	100
	Negative pain coping	176	34.50	18.78	1.42	31.71	37.29	1.00	94
	Low Distress	172	47.21	21.30	1.62	44.00	50.41	0.00	94
	Low self-efficacy and acceptance	74	44.33	24.42	2.84	38.68	49.99	1.00	96

iHOT-12, International Hip Outcome Tool—12.

Conclusions

There was a high prevalence of pain-associated psychological distress in patients presenting to tertiary hip arthroscopy clinics with hip pain. Furthermore, hip quality-of-life outcome scores were uniformly lower in patients with higher levels of psychological distress.

Disclosure

The authors report the following potential conflicts of interest or sources of funding: B.D.L. is a paid consultant for both Stryker and Zimmer. R.C.M. is a board or committee member for the Arthroscopy Association of North America and the North Carolina Orthopaedic Association. All other authors (G.H.C., N.F.K., K.F.S., T.A.L., S.O.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

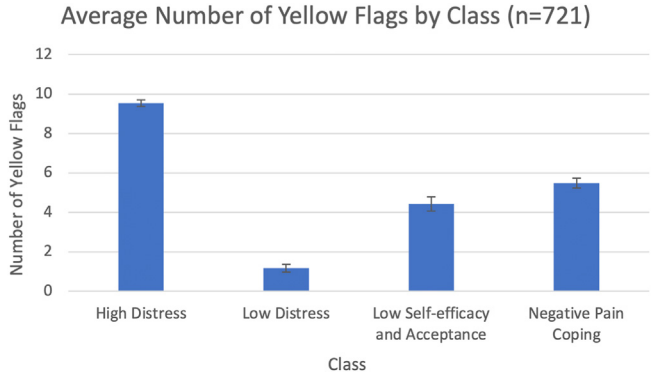

Fig 7. The average number of yellow flags as determined by the Optimal Screening for Prediction of Referral and Outcome—Yellow Flag Assessment Tool across each phenotypic class in our 4-class model. *Error bars are 95% confidence intervals.

References

1. Ward D, Parvizi J. Management of hip pain in young adults. *Orthop Clin North Am* 2016;47:485-496.
2. Sanders SH. Operant conditioning with chronic pain: Back to basics. In: *Psychological Approaches to Pain Management: A Practitioner's Handbook*. New York: Guilford Press, 1996;112-130.
3. Sharp TJ. Chronic pain: A reformulation of the cognitive-behavioural model. *Behav Res Ther* 2001;39:787-800.
4. Dwyer T, Whelan D, Shah PS, Ajrawat P, Hoit G, Chahal J. Operative versus nonoperative treatment of femoroacetabular impingement syndrome: A meta-analysis of short-term outcomes. *Arthroscopy* 2020;36:263-273.
5. Kittelson AJ, George SZ, Maluf KS, Stevens-Lapsley JE. Future directions in painful knee osteoarthritis: Harnessing complexity in a heterogeneous population. *Phys Ther* 2014;94:422-432.
6. Van Dijk GM, Dekker J, Veenhof C, Van Den Ende CH. Course of functional status and pain in osteoarthritis of the hip or knee: A systematic review of the literature. *Arthritis Care Res* 2006;55:779-785.
7. Blagojevic M, Jinks C, Jeffery A, Jordan K. Risk factors for onset of osteoarthritis of the knee in older adults: A systematic review and meta-analysis. *Osteoarthritis Cartilage* 2010;18:24-33.
8. Gandhi R, Zywiel MG, Mahomed NN, Perruccio AV. Depression and the overall burden of painful joints: An examination among individuals undergoing hip and knee replacement for osteoarthritis. *Arthritis* 2015;2015:1-7.
9. Jung JH, Seok H, Kim JH, Song GG, Choi SJ. Association between osteoarthritis and mental health in a Korean population: A nationwide study. *Int J Rheum Dis* 2018;21:611-619.
10. Kittelson AJ, Stevens-Lapsley JE, Schmiege SJ. Determination of pain phenotypes in knee osteoarthritis: A latent class analysis using data from the osteoarthritis initiative. *Arthritis Care Res* 2016;68:612-620.

11. Sharma A, Kudesia P, Shi Q, Gandhi R. Anxiety and depression in patients with osteoarthritis: Impact and management challenges. *Open Access Rheumatol* 2016;8:103.
12. Ramond A, Bouton C, Richard I, et al. Psychosocial risk factors for chronic low back pain in primary care—A systematic review. *Family Pract* 2011;28:12-21.
13. Scopaz KA, Piva SR, Wisniewski S, Fitzgerald GK. Relationships of fear, anxiety, and depression with physical function in patients with knee osteoarthritis. *Arch Phys Med Rehabil* 2009;90:1866-1873.
14. Linton SJ. A review of psychological risk factors in back and neck pain. *Spine* 2000;25:1148-1156.
15. Lentz TA, George SZ, Manickas-Hill O, et al. What general and pain-associated psychological distress phenotypes exist among patients with hip and knee osteoarthritis? *Clin Orthop Relat Res* 2020;478:2768-2783.
16. Becker A, Held H, Redaelli M, et al. Low back pain in primary care: Costs of care and prediction of future health care utilization. *Spine* 2010;35:1714-1720.
17. Flor H, Turk D. Chronic back pain and rheumatoid arthritis: Relationship of pain-related cognitions, pain severity, and pain behaviors. *J Behav Med* 1988;11: 251-265.
18. Jensen MP, Turner JA, Romano JM. Correlates of improvement in multidisciplinary treatment of chronic pain. *J Consult Clin Psychol* 1994;62:172.
19. Keeley P, Creed F, Tomenson B, Todd C, Borglin G, Dickens C. Psychosocial predictors of health-related quality of life and health service utilisation in people with chronic low back pain. *Pain* 2008;135:142-150.
20. Konnopka A, Löbner M, Luppa M, et al. Psychiatric comorbidity as predictor of costs in back pain patients undergoing disc surgery: A longitudinal observational study. *BMC Musculoskelet Disord* 2012;13:1-10.
21. Piva SR, Fitzgerald GK, Wisniewski S, Delitto A. Predictors of pain and function outcome after rehabilitation in patients with patellofemoral pain syndrome. *J Rehabil Med* 2009;41:604-612.
22. Ritzwoller DP, Crounse L, Shetterly S, Rublee D. The association of comorbidities, utilization and costs for patients identified with low back pain. *BMC Musculoskelet Disord* 2006;7:1-10.
23. Rosemann T, Joos S, Szecsenyi J, Laux G, Wensing M. Health service utilization patterns of primary care patients with osteoarthritis. *BMC Health Serv Res* 2007;7:1-8.
24. Hunt MA, Keefe FJ, Bryant C, et al. A physiotherapist-delivered, combined exercise and pain coping skills training intervention for individuals with knee osteoarthritis: A pilot study. *Knee* 2013;20:106-112.
25. Hurley M, Walsh N, Mitchell H, Nicholas J, Patel A. Long-term outcomes and costs of an integrated rehabilitation program for chronic knee pain: A pragmatic, cluster randomized, controlled trial. *Arthritis Care Res* 2012;64: 238-247.
26. Hurley M, Walsh N, Mitchell H, et al. Clinical effectiveness of a rehabilitation program integrating exercise, self-management, and active coping strategies for chronic knee pain: A cluster randomized trial. *Arthritis Care Res* 2007;57:1211-1219.
27. Keefe FJ, Blumenthal J, Baucom D, et al. Effects of spouse-assisted coping skills training and exercise training in patients with osteoarthritic knee pain: A randomized controlled study. *Pain* 2004;110:539-549.
28. Riddle DL, Keefe FJ, Nay WT, McKee D, Attarian DE, Jensen MP. Pain coping skills training for patients with elevated pain catastrophizing who are scheduled for knee arthroplasty: A quasi-experimental study. *Arch Phys Med Rehabil* 2011;92:859-865.
29. Somers TJ, Blumenthal JA, Guilak F, et al. Pain coping skills training and lifestyle behavioral weight management in patients with knee osteoarthritis: A randomized controlled study. *Pain* 2012;153:1199-1209.
30. Lowry V, Ouellet P, Vendittoli P-A, Carlesso LC, Wideman TH, Desmeules F. Determinants of pain, disability, health-related quality of life and physical performance in patients with knee osteoarthritis awaiting total joint arthroplasty. *Disabil Rehabil* 2018;40:2734-2744.
31. Urquhart DM, Phyomaung PP, Dubowitz J, et al. Are cognitive and behavioural factors associated with knee pain? A systematic review. *Semin Arthritis Rheum* 2015;44: 445-455.
32. Foster NE, Delitto A. Embedding psychosocial perspectives within clinical management of low back pain: Integration of psychosocially informed management principles into physical therapist practice—challenges and opportunities. *Phys Ther* 2011;91:790-803.
33. Kent PM, Keating JL, Taylor NF. Primary care clinicians use variable methods to assess acute nonspecific low back pain and usually focus on impairments. *Manual Ther* 2009;14:88-100.
34. Overmeer T, Linton SJ, Holmquist L, Eriksson M, Engfeldt P. Do evidence-based guidelines have an impact in primary care? A cross-sectional study of Swedish physicians and physiotherapists. *Spine* 2005;30:146-151.
35. Loeser JD. Concepts of pain. In: *Chronic Low Back Pain.*. New York: Raven Press, 1982;145-148.
36. Lentz TA, Beneciuk JM, Bialosky JE, 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;46:327-343.
37. Ring D. CORR Insights®: What general and pain-associated psychological distress phenotypes exist among patients with hip and knee osteoarthritis? *Clin Orthop Relat Res* 2020;478:2784.
38. Crijns TJ, Brinkman N, Ramtin S, et al. Are there distinct statistical groupings of mental health factors and pathophysiology severity among people with hip and knee osteoarthritis presenting for specialty care? *Clin Orthop Relat Res* 2022;480:298-309.
39. Levin JM, Baker R, Goltz DE, et al. Heterogeneity of pain-related psychological distress in patients seeking care for shoulder pathology. *J Shoulder Elbow Surg* 2022;31: 681-687.
40. Cardoso JS, Riley JL 3rd, Glover T, et al. Experimental pain phenotyping in community-dwelling individuals with knee osteoarthritis. *Pain* 2016;157:2104.
41. Cruz-Almeida Y, King CD, Goodin BR, et al. Psychological profiles and pain characteristics of older adults with knee osteoarthritis. *Arthritis Care Res* 2013;65:1786-1794.
42. Deveza LA, Melo L, Yamato T, Mills K, Ravi V, Hunter D. Knee osteoarthritis phenotypes and their relevance for

outcomes: A systematic review. *Osteoarthritis Cartilage* 2017;25:1926-1941.
43. Egsgaard LL, Eskehave TN, Bay-Jensen AC, Hoeck HC, Arendt-Nielsen L. Identifying specific profiles in patients with different degrees of painful knee osteoarthritis based on serological biochemical and mechanistic pain biomarkers: A diagnostic approach based on cluster analysis. *Pain* 2015;156:96-107.
44. Knoop J, van der Leeden M, Thorstensson CA, et al. Identification of phenotypes with different clinical outcomes in knee osteoarthritis: Data from the Osteoarthritis Initiative. *Arthritis Care Res* 2011;63:1535-1542.
45. Murphy SL, Lyden AK, Phillips K, Clauw DJ, Williams DA. Subgroups of older adults with osteoarthritis based upon differing comorbid symptom presentations and potential underlying pain mechanisms. *Arthritis Res Ther* 2011;13:1-8.
46. Griffin DR, Parsons N, Mohtadi NG, Safran MR. Multicenter Arthroscopy of the Hip Outcomes Research Network. A short version of the International Hip Outcome Tool (iHOT-12) for use in routine clinical practice. *Arthroscopy* 2012;28:611-618.
47. Gidron Y. Trait anxiety. In: *Encyclopedia of Behavioral Medicine.* 1 New York: Springer, 1989:2013.
48. Gellman MD, Turner JR. *Encyclopedia of Behavioral Medicine*. New York: Springer, 2013.
49. Leeuw M, Goossens ME, Linton SJ, Crombez G, Boersma K, Vlaeyen JW. The fear-avoidance model of musculoskeletal pain: Current state of scientific evidence. *J Behav Med* 2007;30:77-94.
50. Kori S. Kinisophobia: A new view of chronic pain behavior. *Pain Manage* 1990:35-43.
51. McCracken LM, Zayfert C, Gross RT. The Pain Anxiety Symptoms Scale: Development and validation of a scale to measure fear of pain. *Pain* 1992;50:67-73.
52. McCracken LM, Vowles KE, Eccleston C. Acceptance of chronic pain: Component analysis and a revised assessment method. *Pain* 2004;107:159-166.
53. George SZ, Beneciuk JM, Lentz TA, 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;48:460-475.
54. Sullivan MJ, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and validation. *Psychol Assess* 1995;7:524.
55. Waldrop D, Lightsey OR Jr, Ethington CA, Woemmel CA, Coke AL. Self-efficacy, optimism, health competence, and recovery from orthopedic surgery. *J Counsel Psychol* 2001;48:233.
56. Mohtadi NG, Griffin DR, Pedersen ME, et al. The development and validation of a self-administered quality-of-life outcome measure for young, active patients with symptomatic hip disease: The International Hip Outcome Tool (iHOT-33). *Arthroscopy* 2012;28:595-610.e591.
57. Vermunt JK, Magidson J. *Latent GOLD 4.0 user's guide*. Belmont: Statistical Innovations, 2005.
58. Vermunt JK, Magidson J. Latent class models for classification. *Comput Stat Data Anal* 2003;41:531-537.
59. Dean N, Raftery AE. Latent class analysis variable selection. *Ann Inst Stat Mathematics* 2010;62:11.
60. Fop M, Smart KM, Murphy TB. Variable selection for latent class analysis with application to low back pain diagnosis. *Ann Appl Stat* 2017:2080-2110.
61. Islam MM, Valderas JM, Yen L, Dawda P, Jowsey T, McRae IS. Multimorbidity and comorbidity of chronic diseases among the senior Australians: Prevalence and patterns. *PLoS ONE* 2014;9:e83783.
62. Miaskowski C, Dunn L, Ritchie C, et al. Latent class analysis reveals distinct subgroups of patients based on symptom occurrence and demographic and clinical characteristics. *J Pain Symptom Manage* 2015;50:28-37.
63. Horn ME, Reinke EK, Yan X, et al. Use of Patient-Reported Outcomes Measurement Information System (PROMIS) measures to characterise health status for patients seeking care from an orthopaedic provider: A retrospective cohort study. *BMJ Open* 2021;11:e047156.
64. Okafor C, Levin JM, Boadi P, et al. Pain associated psychological distress is more strongly associated with shoulder pain and function than tear severity in patients undergoing rotator cuff repair. *JSES Int* 2023;7:544-549.
65. Chou R, Shekelle P. Will this patient develop persistent disabling low back pain? *JAMA* 2010;303:1295-1302.
66. Wertli MM, Rasmussen-Barr E, Weiser S, Bachmann LM, Brunner F. The role of fear avoidance beliefs as a prognostic factor for outcome in patients with nonspecific low back pain: A systematic review. *Spine J* 2014;14:816-836.e814.
67. Maschke B, Palmsten A, Nelson EO, et al. Injury-related psychological distress and the association with perceived running ability in injured runners. *Phys Ther Sport* 2022;54:36-43.
68. Potter MQ, Wylie JD, Sun GS, Beckmann JT, Aoki SK. Psychologic distress reduces preoperative self-assessment scores in femoroacetabular impingement patients. *Clin Orthop Relat Res* 2014;472:1886-1892.
69. Potter MQ, Sun GS, Fraser JA, et al. Psychological distress in hip arthroscopy patients affects postoperative pain control. *Arthroscopy* 2014;30:195-201.
70. Cheng AL, Schwabe M, Doering MM, Colditz GA, Prather H. The effect of psychological impairment on outcomes in patients with prearthritic hip disorders: A systematic review and meta-analysis. *Am J Sports Med* 2020;48:2563-2571.
71. Dick AG, Smith C, Bankes MJ, George M. The impact of mental health disorders on outcomes following hip arthroscopy for femoroacetabular impingement syndrome: A systematic review. *J Hip Preserv Surg* 2020;7:195-204.
72. Theunissen M, Peters ML, Bruce J, Gramke H-F, Marcus MA. Preoperative anxiety and catastrophizing: A systematic review and meta-analysis of the association with chronic postsurgical pain. *Clin J Pain* 2012;28:819-841.
73. Andrawis J, Akhavan S, Chan V, Lehil M, Pong D, Bozic KJ. Higher preoperative patient activation associated with better patient-reported outcomes after total joint arthroplasty. *Clin Orthop Relat Res* 2015;473:2688-2697.
74. Clode NJ, Perry MA, Wulff L. Does physiotherapy prehabilitation improve pre-surgical outcomes and influence patient expectations prior to knee and hip joint arthroplasty? *Int J Orthop Trauma Nurs* 2018;30:14-19.

75. Lotzke H, Brisby H, Gutke A, et al. A person-centered prehabilitation program based on cognitive-behavioral physical therapy for patients scheduled for lumbar fusion surgery: A randomized controlled trial. *Phys Ther* 2019;99:1069-1088.
76. Griffin DR, Parsons N, Mohtadi NG, Safran MR. A short version of the International Hip Outcome Tool (iHOT-12) for use in routine clinical practice. *Arthroscopy* 2012;28: 611-616. quiz 616-618.
77. Martin RL, Kivlan BR, Christoforetti JJ, et al. Defining variations in outcomes of hip arthroscopy for femoroacetabular impingement using the 12-item International Hip Outcome Tool (iHOT-12). *Am J Sports Med* 2020;48:1175-1180.
78. Impellizzeri FM, Jones DM, Griffin D, et al. Patient-reported outcome measures for hip-related pain: A review of the available evidence and a consensus statement from the International Hip-related Pain Research Network, Zurich 2018. *Br J Sports Med* 2020;54:848-857.
79. Thorborg K, Tijssen M, Habets B, et al. Patient-reported outcome (PRO) questionnaires for young to middle-aged adults with hip and groin disability: A systematic review of the clinimetric evidence. *Br J Sports Med* 2015;49:812.
80. Lindman I, Nikou S, Öhlin A, et al. Evaluation of outcome reporting trends for femoroacetabular impingement syndrome: A systematic review. *J Exp Orthop* 2021;8:33.
81. Jochimsen KN, Mattacola CG, Noehren B, Picha KJ, Duncan ST, Jacobs CA. Low self-efficacy and high kinesiophobia are associated with worse function in patients with femoroacetabular impingement syndrome. *J Sport Rehabil* 2020;30:1-7.
82. Clapp IM, Nwachukwu BU, Beck EC, et al. What is the role of kinesiophobia and pain catastrophizing in outcomes after hip arthroscopy for femoroacetabular impingement syndrome? *Arthrosc Sports Med Rehabil* 2020;2:e97-e104.
83. Montgomery SR, Ngo SS, Hobson T, et al. Trends and demographics in hip arthroscopy in the United States. *Arthroscopy* 2013;29:661-665.
84. Malay MR, Lentz TA, O'Donnell J, Coles T, Mather RC III, Jiranek WA. Development of a comprehensive, nonsurgical joint health program for people with osteoarthritis: A case report. *Phys Ther* 2020;100:127-135.
85. Bermudez A, Franovic S, Moeller J, Makhni EC. Application of PROMIS scores in patients with non-arthritic hip pain presenting to sports medicine clinic. *Clin J Sport Med* 2019;29:154.
86. Domb BG, Chaharbakhshi EO, Rybalko D, Close MR, Litrenta J, Perets I. Outcomes of hip arthroscopic surgery in patients with Tönnis grade 1 osteoarthritis at a minimum 5-year follow-up: A matched-pair comparison with a Tönnis grade 0 control group. *Am J Sports Med* 2017;45: 2294-2302.