Observational Study

Resiliency is a Predictor of Clinical Outcomes in a Chronic Pain Cohort

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Background: Multidimensional strategies to improve pain have advanced the understanding of pain and pain treatment, yet the examination of biopsychosocial factors and associated treatments within pain management has not reached the mainstream.

Objective: The objective of this study was to explore whether psychological variables added to routinely collected medical information were associated with clinical outcomes and the need for additional treatments after an initial chronic pain intervention.

Study Design: This prospective, observational study recruited patients during their initial pain management visits and followed them until they returned to the clinic for additional pain management.

Setting: A private, multispecialty orthopedic clinic in Tallahassee, Florida.

Methods: Patients were seeking treatment for their chronic pain. They completed a series of psychological evaluations, including the Patient Health Questionnaire 9 (PHQ-9), Generalized Anxiety Disorder Scale 7 (GAD-7), Avoidance-Endurance Questionnaire (AEQ), and Connor-Davidson Resilience Scale 10 (CD-RISC-10), in addition to answering lifestyle/behavioral questions. Chart reviews were performed at least one year from the patients' initial visits to understand the response to initial treatment and subsequent clinical management of their pain conditions.

Results: One hundred fifty-two patients completed the full assessment, and 118 returned at least once to the clinic for continued medical care and were included in the models. A previous history of opioid use at the initial visit was a significant positive predictor of change in pain (P = 0.049). The CD-RISC-10 score was a significant negative predictor of the need for additional treatment at the patient's follow-up visit (P = 0.040). Thirteen percent of the cohort reported at least moderate symptoms of anxiety, and 26% of the cohort reported at least moderate symptoms of depression.

Limitations: The limitations of this study were a lack of quantified opioid use and a reliance on self-reported measures.

Conclusion: The inclusion of a resiliency measure along with established psychological instruments appears to add clinical value when managing patients with chronic pain. This study adds to the growing body of evidence that depicts resiliency as an important predictor of clinical outcomes.

Key words: Behavioral health; pain management; anxiety; depression; resilience, chronic pain; mental health

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Despite the emergence of pain as the fifth vital sign and the proliferation of multimodal strategies to combat chronic pain, pain and pain-related diseases are still leading causes of the global disability and disease burden (1). Furthermore, population-based estimates of chronic pain among US adults range from 11-40% (2). Not only is chronic pain a leading cause of disability, but it is also linked to cognitive decline (3,4), opioid addiction (5), and suicidality (6). When annual health care costs and lost productivity are combined, the annual direct and indirect costs of chronic pain are estimated at $560-635 billion (7). When considered collectively, the economic and societal burden of chronic pain presents a formidable challenge.

The transition from acute to chronic pain (i.e., chronification) is based upon many factors, including severity of injury, pathophysiological factors, psychological vulnerabilities, and genetic and environmental risks (8). One of the more complex challenges in treating chronic pain patients lies in identifying those who may be treatment-resistant (i.e., nonresponders) and subsequently implementing strategies to optimize their surgical or interventional outcomes, improve those patients' quality of life, and reduce the burden on the health care system (9). Incorporating a multimodal approach that integrates key biopsychosocial factors, such as mental health and resilience, has been the focus of research more recently (10). Psychiatric factors such as depression and anxiety have also been linked to pain and pain management outcomes (11). Such emphasis further supports the need to identify practical strategies for providers to utilize protocols that improve the classification and treatment of nonresponders.

Previous work by the authors reported on the pilot implementation of a psychological and behavioral health (mental health plus substance use) screening program that identified a cohort of patients who reported elevated symptoms of anxiety and depression as well as low resiliency (12). As the pain field faces the growing costs and uncertainty of an interventional pain model (13), investigations of supplemental factors that may play a role in improving outcomes are needed (14). Among others, these factors include resiliency, a protective trait that can be taught and improved over a relatively short period of time and may contribute to an improved pain experience (15).

Based on the literature showing an association of biopsychosocial factors related to pain outcomes, this study collected these measures as part of clinical care to add to medical history and medical care variables that were already captured during routine care in the electronic medical record (EMR). The purpose of this study was to explore whether those added psychological variables were associated with pain outcomes and the need for additional treatments after an initial chronic pain intervention when considered together with routine medical information collected as part of the EMR.

Methods

Study Design

A convenience sample of pain management patients was recruited from a private, multi-specialty orthopedic clinic in Tallahassee, Florida, from January 2019 to March 2020. This study was approved by the institutional review board of Florida State University (IRB Number: 00000871).

Patients

This prospective, observational study included patients who were seeking treatment for chronic pain and were approached prior to their initial clinical interactions at the pain management clinic.

Following voluntary participation, consent, and disclosure authorization, patients completed a series of validated psychological measures, including the Patient Health Questionnaire 9 (PHQ-9) (16), Generalized Anxiety Disorder 7 scale (GAD-7) (17), Avoidance-Endurance Questionnaire (AEQ) (18), and Connor-Davidson Resilience Scale 10 (CD-RISC-10) (19). The PHQ-9 (16,20) and GAD-7 (21,22) are well-established instruments that have been used in both the general and clinical settings to identify symptom severity that can impact clinical outcomes. To these authors' knowledge, the PHQ-9 remains one of the most widely used and validated tools for measuring depression worldwide. The GAD-7 is also widely used in both clinical and research settings and, although not as well researched as the PHQ-9, remains a repeatedly validated tool across cultures (23,24). The AEQ and CD-RISC-10 are less researched measures that were previously deployed in chronic pain cohorts or low back pain cohorts (18,25,26). AEQ has been shown to be a reliable and valid measure to assess the patterns of fear-avoidance and endurance-related responses to pain. CD-RISC-10 a shorter version of the full-length resiliency scale but has also demonstrated high reliability and validity (27). Medical records were reviewed at least one year from the patients' initial visit to determine their demographic characteristics and pertinent

medical information, including response to treatment and subsequent clinical management of their pain condition. The patients' histories of opioid use were based on the prescription records kept in the practice's electronic health record system. This research was approved by the Florida State University Institutional Review Board. There were no protocol deviations, and the study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (Fig. 1) (28).

Measurement

Psychological Measures

The PHQ-9 was used to measure symptoms of depression (16). The PHQ-9 is among the most widely used measures of risk for major depressive disorder in medical settings. The PHQ-9, which is a brief self-report measure used for identifying symptoms of depression, has been shown to have strong psychometric properties in a variety of settings (29,30). To measure symptoms of anxiety, the GAD-7 was used (17). The GAD-7 is a self-report measure that has been shown to be a valid tool for identifying anxiety symptoms in both the general population (31) and psychiatric population (32), with strong psychometric properties across settings. The total severity scores for both the GAD-7 and PHQ-9 were used in the analyses. The Avoidance-Endurance Questionnaire (AEQ) was used to measure the pattern of fear-avoidance and endurance-related responses to pain (18). The AEQ was developed from the Kiel Pain Inventory and is a reliable and valid measure that has been used repeatedly within the context of pain with strong psychometrics (25,26). The AEQ subscales were used in the analyses. The Connor-Davidson Resilience Scale 10 (CD-RISC-10) was used to measure resiliency, (i.e., the ability to respond positively when facing trauma or stress) (27). The CD-RISC-10 is a brief, 10-item self-reported tool that measures resiliency and has been shown to be an efficient measure with strong psychometric properties (33,34) (Suppl. Table 1).

Medical Record and Other Variables

The minimally clinically important difference (MCID) for the numeric pain rating scale (NPRS) was 2 points on a 0-to-10 scale. The MCID was selected and based on seminal work (35) (i.e., approximate improvement of 2 points) in chronic pain and a recent systematic review that suggested approximately 2.0 to 2.3 points (36). This threshold was used to determine if there was an improvement in the patient's pain and if the patient responded to treatment. The "referred for treatment" variable consisted of any additional treatment recommendations that were made after the follow-up visit (e.g., medication management, diagnostic imaging studies, physical therapy, interventional procedure, counseling, or surgery). Demographic information and medical history were collected from the medical record. Patients were also asked about substance use, organized athletics participation, and previous com-

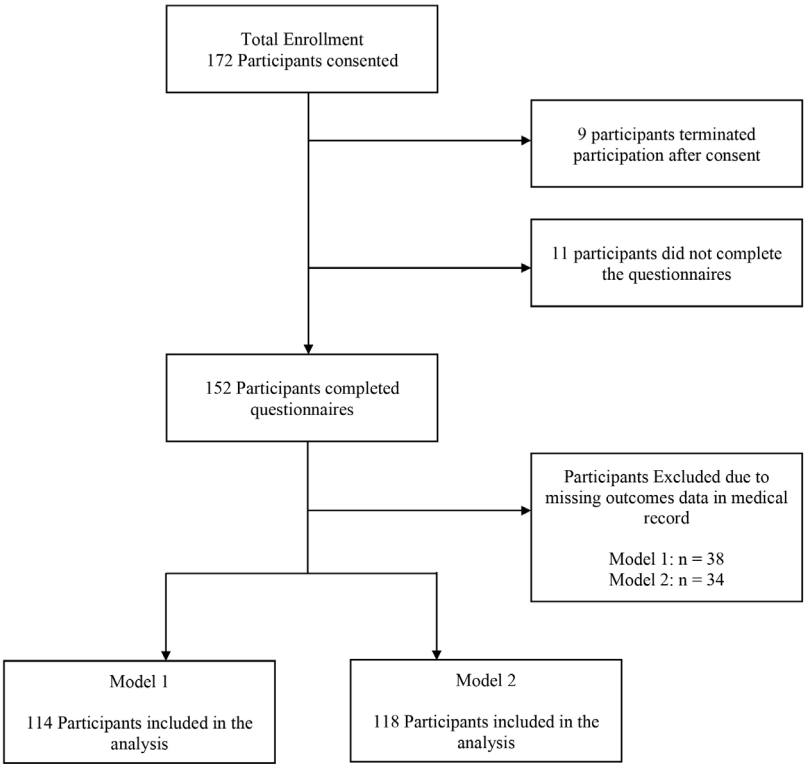

Fig. 1. *STROBE Flow Chart.*

plications while receiving medical care. Self-reported weekly moderate and vigorous exercise intensity was based on questions 1-4 on the International Physical Activity Questionnaire Self-Administered Short Form (Last 7 Days format) (37).

Statistical Analysis

Prior to our conducting of multivariate analyses, descriptive data and bivariate relationships among key study variables and the 2 outcome variables were summarized and calculated (Suppl. Table 2). Cohort characteristics are provided in Table 1. Based on the prior literature and results of bivariate analyses, we conducted multivariate analyses to examine the effects of the psychological variables along with key demographic and medical history. For the dichotomous outcome variable, "need for further treatment," a logistic regression was employed. General linear modeling was used to examine the association of the psychological, demographic, and medical variables on the "change in pain" outcome. Statistical analysis was performed with SAS (version 9.4) statistical software. Data collection was performed using Qualtrics software (Qualtrics).

Model 1: Change in Pain Outcome

Change in pain was defined as the difference in reported pain score (i.e., 0-10) between the initial and the first follow-up visit. Independent variables in the final model were selected based on which research questions were related to the association of psychological variables to change in pain, as well as bivariate associations. The final independent variables included in Model 1 were age, gender, work status, opioid use, recreational drug use, diabetes diagnosis, and GAD-7 total.

Model 2: Referred for Treatment

The dependent variable for this project was a dichotomous variable for referring treatment (no = 0; yes = 1), and logistic regression was used to identify the significant predictors for additional treatment. Independent variables in the final model were selected based on which research questions were related to the association of psychological variables to referral for additional treatment, as well as bivariate associations. The final independent variables included in Model 2 were age, PHQ-9, GAD-7, CD-RISC-10, AEQ Positive Mood Despite Pain, AEQ Avoidance of Social Activities, abnormal blood lipids, regular exercise status, tobacco use status, tobacco smoking in the last 7 days, and work status.

Results

Demographic Characteristics

Demographic, medical, and psychological characteristics of the cohort are presented in Table 1. Of 152 patients, 118 patients returned for a follow-up visit. Of the 118 patients who returned for a follow-up visit, 28 (24%) reported pain improvement that met or exceeded the MCID threshold. The cohort was 59.1 ± 14.3 years with a BMI of 31.6 ± 5.9 kg/m^2, and the majority were women (59%). When examining the individual treatment modalities the patients received between their initial visit and follow-up visit, we found that 49% underwent interventional pain procedures, 48% received medication management, 12% underwent physical therapy, 8% participated in psychological counseling, 4% received advanced diagnostic imaging, and 0% received surgery. When examining the need for additional treatment after their follow-up visit, we discovered that treatment proportions for interventional pain procedures, medication management, physical therapy, counseling, advanced diagnostic imaging, and surgery were 4%, 50%, 15%, 10%, 24%, 0%, respectively.

Based on screener scores and clinical cutoffs for the GAD-7 (≥ 10) and PHQ-9 (≥ 10), 13% of the patients exhibited symptoms of moderate to severe anxiety, and 26% reported symptoms of moderate to severe depression (Table 2). For the CD-RISC-10, 36% of patients exhibited resiliency scores at or below the lowest quartile (≤ 29).

Model 1: Change in Pain

The General Linear Model (GLM) analysis examined the relationship between the dependent variable Change in Pain from Visit 1 to Visit 2 [and several independent variables (e.g., clinical and psychological).] The analysis showed that the model was statistically significant (F = 4.46; *P* = 0.049). A total of 22.1% of the variation in Change in Pain could be explained by the model (R-squared value). Among the independent predictors, only a history of opioid use at the time of the initial visit was found to have a statistically significant association with Change in Pain (Table 3). In other words, the pain levels of patients who had taken opioids were likely to rise or to remain elevated over those of patients who had not taken opioids.

Model 2: Referred for Treatment

The dependent variable in the logistic regression analysis was named Referred for Treatment (no

Table 1. *Patient demographics and medical history.*

	Total Cohort (n = 152)
Age (years)	59.1 ± 14.3
Gender (Male % of cohort)	63 (41.5%)
Body Mass Index (kg/m^2; n = 107)	31.6 ± 5.9
Type of Insurance	
Government	81 (53.3%)
Commercial/ Worker's Comp	71 (46.7%)
Active Work Status (n = 115)	47 (40.9%)
Current Opioid Use (n = 151)	70 (46.4%)
Current Benzodiazepine Use (n = 151)	36 (23.8%)
Reported Recreational Drug Use (n = 134)	10 (7.5%)
Cannabis or Related Intake in the last 7-day (n = 46)	10 (21.7%)
Diabetes (n = 147)	23 (15.7%)
Ambulation Status at Initial Visit (n = 149)	
Unassisted	136 (91.3%)
Cane/Walker/Wheelchair	13 (8.7%)
Tobacco Use (n = 143)	66 (46.2%)
Tobacco Smoker in the last 7 days (n = 118)	21 (17.8%)
Alcohol Use (n = 129)	66 (51.2%)
Alcohol Drinker in the last 7 days (n = 46)	16 (34.78%)
Regular Moderate-to-Vigorous Exercise (n = 114)	82 (71.9%)
Abnormal Blood Lipids	52 (35.6%)
High School Athlete (n = 46)	18 (39.1%)
Number of Comorbidities	1.6 ± 1.4
Body Part(s) Affected	
Spine	70 (46.1%)
Upper Extremity	6 (4.0%)
Lower Extremity	24 (15.8%)
Spine + Extremity	45 (29.6%)
Upper + Lower Extremity	7 (4.6%)

Data reported as # (% of cohort) or mean ± SD.

Table 2. *Clinical variables and behavioral health survey scoring.*

	Total Sample Size: n = 152
NPRS	6.8 ± 2.0
At least Moderate Symptoms on PHQ-9 (≥10)	54 (13%)
At least Moderate Symptoms on GAD-7 (>10)	17 (26%)
At or below lowest quartile on CD-RISC-10 (≤29)	40 (36%)
AEQ Fear-Avoidance Responses	
Anxiety / Depression	1.6 ± 1.1
Help / Hopelessness	1.9 ± 1.3
Catastrophizing	0.7 ± 0.9
Avoidance of Social Activities	2.4 ± 1.8
Avoidance of Physical Activities	4.2 ± 1.4
AEQ Endurance Responses	
Positive Mood Despite Pain	3.3 ± 1.5
Thought Suppression	2.7 ± 1.7
Humor / Distraction	2.5 ± 1.0
Pain Persistence	3.2 ± 0.9

Data reported as # (% of cohort) or mean ± SD. NPRS = Numeric Pain Rating Scale; PHQ-9 = Patient Depression Questionnaire 9; GAD-7 = General Anxiety Disorder-7; CD-RISC-10 = Connor-Davidson Resilience Scale 10; AEQ = Avoidance-Endurance Questionnaire

Table 3. *Model 1, results of general linear model with pain outcome.*

Predictor	Estimate	Standard Error	t-value	*P*-value
Age	-0.019	0.016	1.25	0.216
Gender	-0.370	0.373	-0.99	0.324
Work Status	0.356	0.436	0.82	0.416
Opioid Use	0.742	0.371	2.00	0.049
Recreational Drug Use	1.229	0.633	1.94	0.056
Diabetes	-0.451	0.652	-0.69	0.491
GAD-7 Total	0.078	0.043	1.82	0.073

(n = 114); GAD-7 = General Anxiety Disorder-7

= 0; yes = 1). The logistic regression model identified the CD-RISC-10 score as the only significant predictor that a patient would be referred for treatment after the subsequent follow-up visit (P = 0.040) (Table 4). This finding suggests that the CD-RISC-10 score had a significant impact on the likelihood of being referred for treatment. The odds ratio estimates provide further insights into the relationship between the predictor variables and treatment referral. For every one-unit increase in CD-RISC-10 score (i.e., greater resiliency), the odds of being referred for treatment decreased by approximately 14.7% (1 - 0.853). In other words, higher CD-RISC-10 scores were associated with a lower likelihood of being referred for treatment.

Discussion

This prospective, observational study was designed to determine if demographic, medical history, or psychological screener responses could predict changes in pain for chronic pain patients (Model 1) or the need for additional treatment after the patients' initial in-

Table 4. *Model 2, logistic regression with referred for additional treatment.*

Predictor	Odds Ratio	95% Wald Confidence Limits	Wald Chi-Square	*P*-value
Age	0.972	0.920 - 1.026	1.046	0.307
PHQ-9 Total	0.979	0.795 - 1.205	0.041	0.840
GAD-7 Total	0.954	0.769 - 1.183	0.187	0.665
CD-RISC-10 Score	0.853	0.734 - 0.993	4.229	0.040
AEQ PMS Positive Mood	1.261	0.715 - 2.224	0.6423	0.423
AEQ ASAS Avoidance social	1.110	0.779 - 1.582	0.333	0.564
Regular Exercise	3.946	0.781 - 19.941	2.758	0.097
Abnormal Blood Lipid	0.438	0.125 - 1.535	1.664	0.197
Tobacco Smoker in last 7-days	5.458	0.700 - 42.577	2.622	0.105
Work Status	0.999	0.245 - 4.073	0.000	0.999
Tobacco Use	1.576	0.162 - 2.047	0.728	0.394

(n = 118); PHQ-9 = Patient Depression Questionnaire 9; GAD-7 = General Anxiety Disorder-7; CD-RISC-10 = Connor-Davidson Resilience Scale 10; AEQ = Avoidance-Endurance Questionnaire; PMS = Positive Mood Scale; ASAS = Avoidance of Social Activities Scale

tervention (Model 2). This design was accomplished by examining medical records at least one year after each patient's initial office visit to allow follow-up treatments. Of the 118 patients who returned to the clinic, only 24% reported a clinically important improvement in pain (i.e., ≥ 2-point reduction in pain) from their initial visit to their follow-up. Consequently, many patients required additional pain-related treatment after their follow-up visits.

When we attempted to predict changes in pain, we found that the results in Model 1 demonstrated that patients who had taken opioids were less likely to experience improved pain levels than were patients who had not taken opioids. Although our findings were not causal, they align with numerous studies recently published on the deleterious effects of chronic opioids and their impact on post-operative results (38-40). Additionally, the use of opioids may have increased patients' pain levels or kept them elevated over those of patients who were not using opioids, which has previously been demonstrated after knee arthroplasty (41). However, some limitations of our study were that the history of opioid use was neither quantified based upon morphine milligram equivalents (MME) nor confirmed using a program that monitored prescription drugs and that urine drug screenings were not used to confirm drug consumption for all patients. Additionally, patients may have received opioids from clinicians outside of the study site's knowledge before becoming patients of the practice, and the study team may have unintentionally mislabeled them as opioid naïve if they were no longer receiving opioid prescriptions, though we expect that such patients represent a very small subset. Therefore, further investigation is needed to draw any correlation between opioid load and pain. The question remains of whether the opioids are causative agents for poor outcomes, if these patients self-select for opioid loading as one of their maladaptive behaviors, or if the combined psychosocial milieu is the ultimate cause. There is conflicting literature on this topic (42-44), and therefore, it is incumbent upon the physician to consider all the relevant comorbidities when embarking on an opioid-based regimen.

Reported risk factors such as obesity (45), opioid use (46), work/disability status (47), and anxiety were all considered in model development. Prior published studies that measured anxiety with the GAD-7 showed utility in predicting change in pain (48,49), but the association was not statistically significant in this cohort. This phenomenon has recently been reported in a cohort of spine fusion surgeries with increased anxiety, as reflected by elevated GAD-7 scores trending toward longer time before discharge and increased opioid use at 6 months (50). Flanigan et al (51) also reported on the effects of psychological vulnerabilities and discussed a practical approach for addressing these concerns as they related to the timing of orthopedic knee surgery. The prevalence of anxiety and depression in the chronic pain population has been well described (52-54), as has those conditions' negative impact on the outcomes of not only surgical procedures but also interventional pain procedures (55–57). However, PHQ-9 (depression symptomology) and GAD-7 (anxiety symptomology) scores were not predictive of the outcomes in this study's cohort.

When we assessed the need for further treatment utilizing the predictor variables in Model 2, we discovered that the CD-RISC-10 score was the only significant predictor. The higher a patient's resilience (as measured by the CD-RISC-10), the lower the need for referrals for additional treatment. This study adds to the existing body of literature describing the influential and protective nature of resilience in a variety of clinical settings and patient populations in both the short and long term, including chronic pain (58), complex regional

pain syndrome (59), total shoulder arthroplasty (60), total hip arthroplasty (61), total knee arthroplasty (62), spinal cord injury (63,64), multiple sclerosis (65), trauma surgery (66), and arthroscopic surgery (67). With the existing evidence, research efforts must be made to establish accessible, feasible, and effective programs or expand on existing framework that can allow for the development of skills that build greater resilience for at-risk patients suffering from chronic pain (68-74).

Reliance on self-reported measures and the lack of a quantifiable opioid load are 2 major limitations of the current study. Furthermore, 22% of the recruited patients did not return for clinical care. This level of data loss could have had an impact on the outcome measures and models. Additionally, it cannot be ascertained whether the patients returned because of they experienced the restoration of function or the resolution of their symptoms and/or pain, although the data collection window was at least one year from the patients' initial visit. Additionally, a year is generally sufficient time from an initial visit to its follow-up in the clinic where the investigation was performed.

In summary, psychological distress was present in roughly a quarter of patients seeking treatment for chronic pain. Those who were using opioids were more likely to have their pain increase or remain elevated than were those who were not on an opioid regimen at the time. Moreover, patients who had higher levels of resilience were less likely to need further treatment after the initial treatment. As discussed throughout, screeners appear effective in giving providers an opportunity to briefly identify patients who may benefit from integrated psychological intervention and/or referral in the context of pain management. The administration of such screeners can be flexible and administered by nonclinical staff, making the utilization more attainable in a busy clinic setting. Future studies should explore various ways to enhance patient engagement by addressing these psychological vulnerabilities (75).

Conclusions

There is a great need to identify predictors of change in pain and the need for additional therapies after the initial intervention. Previous literature has reported the impact of psychological factors on surgical outcomes (76-79). This project was able to feasibly integrate psychological screeners within a busy outpatient orthopedic clinic (12). Those psychological screening tools (GAD-7, PHQ-9, and CD-RISC-10) were used as part of routine care at the clinic to identify patients with symptoms of anxiety and depression as well as the protective effects of resilience (12).

These screeners have demonstrated ease of use and predictability during attempts to identify adjunct tools for determining outcomes. Future studies may explore novel methods to have an impact current opioid utilization with concurrent vulnerabilities, including states of low resilience.

Author Contributions

GSC, PRW, and HAF contributed to the study's conceptualization and design, data acquisition, analysis, and interpretation, and manuscript preparation, editing, and final approval. FS and PRG contributed to the data analysis and interpretation and manuscript preparation, editing, and final approval. AMR contributed to data interpretation and manuscript preparation, editing, and final approval. All authors agree to be accountable for ensuring the accuracy and integrity of the work.

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Supplemental Table 1. *Abbreviated Constructs of the CD-RISC-10*

Item	Description
1	Able to adapt to change
2	Can deal with whatever comes
3	Tries to see humorous side of problems
4	Coping with stress can strengthen me
5	Tend to bounce back after illness or hardship
6	Can achieve goals despite obstacles
7	Can stay focused under pressure
8	Not easily discouraged by failure
9	Thinks of self as strong person
10	Can handle unpleasant feelings

CD-RISC-10 = 10-item Connor-Davidson Resilience Scale

Supplemental Table 2. *Bi-variate Correlation of proposed predictors with both outcome measures*

Variable	Change in Pain	Referred for Treatment
	P-Value	*P*-Value
Gender	0.0611[1]	0.8415[3]
Insurance	0.8936[1]	0.2986[3]
Work Status	0.5603[1]	0.0588[3]
Opioid Use	0.2595[1]	0.3640[3]
Benzodiazepine Use	0.3149[1]	0.7518[3]
Ambulation	0.5769[1]	0.4256[3]
Current Tobacco Use	0.2544[1]	0.0044[3]
Current Alcohol Use	0.9237[1]	0.6034[3]
Recreational Drug Use	0.0186[1]	0.1598[3]
Regular Exercise	0.4494[1]	0.0071[3]
Hypertension	0.6896[1]	0.4006[3]
Abnormal Blood Lipids	0.5819[1]	0.0006[3]
Heart Disease	0.4498[1]	0.6642[3]
COPD	0.6957[1]	0.7416[3]
Diabetes	0.0056[1]	0.1355[3]
Anxiety	0.8989[1]	0.5920[3]
Depression	0.3145[1]	0.6481[3]
Neurodegenerative	0.5982[1]	0.1387[3]
Fibromyalgia	0.8535[1]	0.8633[3]
Cerebral Vascular	0.9471[1]	0.6409[3]
Body Parts Affected	0.6378[1]	0.1376[3]
Previous Treatment	0.6417[1]	0.3208[3]
Tobacco Smoker in the last 7 day	0.6010[1]	0.0476[3]
Alcohol Drinker in the last 7 day	0.6794[1]	0.6121[3]
Cannabis or Related Intake in the day	0.0446[1]	0.0553[3]
Previous Complication after S	0.1374[1]	0.7108[3]
High School Athlete	0.3667[1]	0.0399[3]
College Athlete	0.528[1]	0.4393[3]

Supplemental Table 2 cont. ***Bi-variate Correlation of proposed predictors with both outcome measures***

Variable	Change in Pain	Referred for Treatment
	***P*-Value**	***P*-Value**
Age Integer	0.0700[2]	0.0021[4]
BMI	0.5242[2]	0.4156[4]
Comorbid Sum	0.9074[2]	0.0962[4]
Days Since Initial	0.1869[2]	0.8781[4]
Moderate Exercise Intensity Week	0.9419[2]	0.9168[4]
Vigorous Exercise Intensity Week	0.5826[2]	0.2927[4]
PHQ_9_Total	0.1224[2]	0.2904[4]
GAD_7_Total	0.0116[2]	0.3325[4]
CD_RISC_10_Score	0.8925[2]	0.0521[4]
ADS Anxiety Depression	0.1900[2]	0.2358[4]
PMS Positive Mood	0.5063[2]	0.0735[4]
HHS Help Hopelessness	0.7913[2]	0.4103[4]
CTS Catastrophizing	0.9917[2]	0.6291[4]
TSS Thought Suppression	0.8212[2]	0.9317[4]
ASAS Avoidance social	0.1192[2]	0.0364[4]
APAS Avoidance physical	0.9712[2]	0.2391[4]
HDS Humor Distraction	0.6601[2]	0.5005[4]
PPS Pain Persistence	0.7864[2]	0.8665[4]

n = 152
1 One-way ANOVA p-value, 2 Bivariate Correlation *p*-value,
3Chi-Square *p*-value, 4 Logistic regression *p*-value.