12-2015

Psychometric Properties of the Centrality of Pain Scale

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Citation Details

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Number of Tables: 4
Number of Figures: 0
Running Title: Psychometric properties of the Centrality of Pain Scale

Abstract

The Centrality of Pain Scale (COPS) is a recently developed, patient-centered, 10-item self-report measure designed to assess how central, or dominating, individuals with chronic pain perceive pain in their life. The COPS previously underwent initial development and validation, and preliminary results suggested that the measure had excellent psychometric properties and COPS scores were associated with important clinical factors. The purpose of the present study is to examine the psychometric properties of the COPS in a sample of individuals with mixed chronic pain diagnoses (n=178) being treated at a US Veterans Affairs Medical Center. Principal component analysis of COPS items revealed a single factor and all items loaded highly. The COPS had high internal consistency (Cronbach's alpha=0.902) and was significantly correlated with other measures of pain, mental health, psychological factors associated with pain, and chronic pain coping styles, suggesting convergent and divergent validity. Hierarchical linear regression analyses indicated that COPS score was independently associated with both pain severity and interference. Future research should evaluate the generalizability of the COPS in different samples, its responsiveness to treatment, and the extent to which pain centrality may be a focus of non-pharmacological interventions for chronic pain.

Perspective: We conducted psychometric testing of the Centrality of Pain Scale (COPS), a recently-developed patient-centered self-report measure designed to examine how central or dominating pain is to a person's life. Study results indicated a reliable and valid measure, which was significantly associated with pain severity and interference, even after controlling for demographic and clinical factors.

Key Words: Pain centrality; Chronic pain; Biopsychosocial model; Reliability; Validity; Patient-centered care

Introduction

Chronic pain is among the most common reasons for seeking outpatient medical treatment.[9] There are many commonly utilized and well-validated self-report measures that assess pain intensity, function, and quality of life available.[26] There are also well-validated measures of psychological constructs that are highly predictive of pain and functioning, and that may potentially be the focus in non-pharmacological interventions for chronic pain (e.g., self-efficacy for managing chronic pain, pain catastrophizing, fear avoidance).[27,29] However, these measures address specific constructs and may not fully capture the patient's overall experience of chronic pain and its impact on his or her life. For example, some patients may have limited function or high pain intensity, but believe that they have good pain control. Alternatively, other patients may feel their pain is out of control even though they have fewer functional limitations or lower pain intensity. Thus, many assessment questionnaires may need to be used in combination, which may increase patient burden.

The Centrality of Pain Scale (COPS) is a brief 10-item self-report measure designed to assess the centrality of pain.[19] "Pain centrality" is a term to describe a patient-centered concept related to how central pain is to a person's life; that is, how much it dominates or "takes over" their life. The concept of pain centrality arose from the frustration primary care providers report experiencing in trying to use existing pain measures to capture the patient's experience and to use as a basis for goal setting.[8] Patients' pain intensity scores or functional assessments may not correlate with patients' experience of pain.[14] Similarly, there may often be a disconnect between traditional pain measures and patient or clinician assessment of the effectiveness of pain control.[13,21] For example, some patients may feel that their pain control has greatly improved with treatment despite still having high pain intensity scores and significant functional limitations. What may matter most is how much pain is dominating their lives. The concept of the "centrality of pain" may explain how well patients are doing overall. Though multiple physical, psychological, and social factors may influence a patient's experience of pain, the

COPS is intended to efficiently measure the *overall effect* of these various factors on the individual's own perception of how much pain is dominating his or her life. Pain centrality is not to be confused with the biological phenomenon of pain centralization.[2]

The COPS originally included 12 items, which were developed to assess a domain that has been hypothesized to be an important issue for patients and overcomes some barriers of other pain-related measures.[22,23,30] The original items were adapted based on input from colleagues and patients. The COPS was originally tested in a sample of 65 adult internal medicine patients with chronic non-cancer pain. Cognitive interviewing was conducted to test construct validity, which revealed that patients' understanding of the items matched the intended concept and that patients felt the scale covered an important concept not captured by other measures of pain severity or function. Two of the original items were removed because responses did not show sufficient variability. The final 10-item scale had excellent internal consistency and convergent validity. COPS scores were significantly associated with self-reported pain intensity, disability, mental health, quality of life, and clinician assessment of how well the patient's pain was controlled.[19]

The purpose of the current study was to replicate the previous preliminary results by conducting additional examination of the psychometric characteristics of the COPS in an adult sample of patients with persistent pain who were being treated at a Veterans Affairs Medical Center. In addition to including well-validated measures of pain severity, function, and symptoms of depression and anxiety, we included measures of other factors that may be correlated with pain centrality (i.e., self-efficacy for managing pain, pain catastrophizing, methods of coping with pain). As a final issue, given the problem of prescription opioid misuse and abuse,[6,31] we sought to examine potential associations between pain centrality and risk for prescription opioid misuse. We did not have preliminary data to guide this aim and viewed the relationship between COPS score and risk for prescription opioid misuse as exploratory.

Materials and Methods

Participants

Participants in this study were originally recruited for a larger examination of factors associated with chronic pain in patients with the hepatitis C virus.[17] Participants were recruited by notices posted throughout the medical center, letters sent to patients who had pending appointments in primary care clinics, announcements made in mental health classes, and referral from the hospital's Hepatology Clinic.

Participants were included in this study if they had been tested for hepatitis C (regardless of whether the results were positive or negative), were at least 18 years old, and English-speaking. A total of 91 individuals were screened and excluded from participation. Exclusion criteria were pending litigation or disability compensation for pain (n=28), advanced liver disease (n=50), current suicidal ideation (n=2), or other serious psychiatric condition such as untreated bipolar disorder or schizophrenia (n=2), age over 70 years (n=1), a non-veteran (n=3), cognitive impairment that precluded participation (n=2), and incomplete responses to eligibility screening questions (n=3).

For inclusion in this analysis, participants must have endorsed a current chronic pain diagnosis and had medical record documentation of treatment for a pain-related condition within the past five years. A sample of 178 individuals met these criteria. This study was approved by the Institutional Review Board of the VA Medical Center where the study was conducted. All participants signed informed consent to participate, were administered self-report questionnaires in a single one-to-one session with a research assistant, and received a $30 store gift card as compensation.

Data Collection

Demographic data were obtained directly by participants' self-report. These data included age, gender, race, marital status, years of education, and current annual income.

The Centrality of Pain Scale (COPS) is a 10-item self-report measure designed to assess the extent to which pain dominates a patient's life.[19] Each item is scored on a 5-point

Likert scale where 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, and 5=strongly agree. Three items are reverse scored. Total scores range from 10 to 50 with higher scores indicating greater pain centrality. As noted, the initial psychometric evaluation of the COPS indicated strong internal consistency and construct validity.

Pain severity and interference were assessed using two subscales of the Multidimensional Pain Inventory (MPI), a well-validated and frequently used measure.[11] Scores range on a scale from 0 to 6, which higher scores reflecting more severe pain or greater life interference. The Pain Catastrophizing Scale[24] is a 13-item self-report measure and was administered to assess pain catastrophizing, a tendency to misinterpret and exaggerate situations that may be threatening.[28] Higher scores reflect heightened distress responses to pain. The Chronic Pain Self-Efficacy Scale[3] is a 22-item self-report questionnaire designed to assess perceived ability to manage pain. Higher scores indicate greater self-efficacy.

The Chronic Pain Coping Inventory (CPCI) is a 64-item measure used to assess ways in which individuals cope with chronic pain.[10] The CPCI is comprised of eight scales: guarding, resting, asking for assistance, relaxation, task persistence, exercise/stretching, use of coping self-statements, and seeking social support. Higher scores on subscales indicate greater use of the particular coping strategy.

Depressive symptoms were assessed with Beck Depression Inventory – 2 (BDI-II), a well-validated and commonly used 21-item self-report questionnaire.[4] Higher scores on the BDI-II reflect more severe symptoms of depression. Current anxiety symptoms were evaluated with the Generalized Anxiety Disorder Scale (GAD-7), a seven-item questionnaire that assesses the presence of generalized anxiety disorder.[25] Scores on the GAD-7 are also strongly correlated with other anxiety disorders, including posttraumatic stress disorder, panic disorder, and social anxiety disorder.[12]

Risk for prescription opioid misuse was assessed with the Pain Medication Questionnaire, a 26-item self-report measure.[1] Higher scores suggest greater risk of prescription opioid misuse.

We reviewed data from the electronic medical record to determine whether participants had a current prescription for an opioid medication. Pain diagnostic data were generated to describe sample characteristics and were extracted from the medical record using ICD-9-CM codes listed in medical encounter records for the five years prior to the study assessment.

Data Analysis

Demographic data were analyzed with measures of central tendency. An exploratory principal components analysis with varimax rotation was conducted to identify underlying factors of the COPS. Pearson correlations were conducted between COPS total score and other measures of pain, interference, and mental health. Two separate hierarchical linear regression analyses were conducted to determine if COPS score was significantly associated with pain severity and pain interference, after controlling for potential confounding variables. The first step of these models controlled for the demographic characteristics age, gender, race, and income (these variables were all inserted into the model). Data screening procedures identified high intercorrelations among the pain and mental health variables. We thus performed a forward stepwise linear regression for the pain and mental health variables. Only variables with statistically significant correlations with pain intensity or pain interference were eligible for inclusion as candidate variables in these analyses. Forward stepwise regression was used as the data reduction technique because this was an exploratory study and our goal was to determine if COPS scores were significantly associated with pain outcome variables above and beyond the effects of other demographic and clinical variables. Variables were entered into the model if they significantly improved the model beyond the $p < 0.05$ level. We chose this cutoff criterion to ensure retention of clinical variables most strongly associated with the pain outcomes while maintaining model parsimony.

Results

Participants included in this analysis (n=178) were on average 54.7 (SD=7.7) years old,

male (92.1%), Caucasian (75.8%). 25.8% were married while 50% were divorced or separated

(Table 1). The mean and frequency scores of the COPS were not significantly associated with

any demographic characteristic. The most common pain-related diagnoses among participants

were neck or joint pain (77.0%), low back pain (64.2%), and arthritis (59.7%). Participants

reported an average duration of pain of 12.8 (SD=11.5) years. At the time of this research visit,

40.4% of participants were prescribed a current opioid medication.

The mean COPS score in this sample was 28.8 (SD=8.5). Internal consistency,

Cronbach's alpha, for the scale was .902. Pearson correlations were conducted to assess

associations between the COPS and other measures of pain, interference, and mental health

(Table 2). COPS total scores were highly and positively correlated with measures of pain

severity, pain interference, pain catastrophizing, depressive symptoms, anxiety symptoms, and

risk for prescription opioid misuse (all $p<0.001$). COPS total scores also correlated negatively

with chronic pain self-efficacy ($r = -0.73$, $p<0.001$). The COPS was positively correlated with

subscales of the CPCI assessing Guarding, Resting, and Asking for Assistance (correlations

range from $0.24 - 0.49$, p-values ≤ 0.001). It was negatively correlated with Task Persistence ($r = -0.34$, $p<0.001$).

Principal components analysis with varimax rotation was conducted with the 10 COPS

items. Factors with eigenvalues greater than 1.0 were retained. A single factor emerged and

accounted for 53.9% of the variance. All scale items loaded highly on this factor with loadings

ranging from .586 – .828 (Table 3).

A multivariate hierarchical linear regression analysis identified correlates of pain severity.

This model controlled for age, gender, race, and income in the first model step. The overall step

was non-significant, Step 1 $F = 1.17$, $p = 0.325$, as were each of the individual demographic

covariates. In subsequent steps, a forward selection stepwise multiple regression was carried

out. In order for a new variable to enter the model, it would have to increase R^2 beyond the $p <$ 0.05 level. Candidate variables included only those that maintained statistically significant correlations with pain severity (Table 2). Table 4 indicates that the final model included demographic variables, pain interference, and centrality of pain together accounting for 54.1% of the variance in pain severity. No other variables entered the model.

A second multivariate hierarchical linear regression was conducted to examine correlates of pain interference. Step 1, which included demographic characteristics was not significant, Step 1 $F = 1.59$, $p = 0.180$, as were each of the individual demographic covariates. In subsequent steps, a forward selection stepwise regression was carried out. The final model included the variables pain severity, centrality of pain, CPCI Guarding, CPCI Relaxation, current prescription opioid status, and anxiety severity (Table 4). This model accounted for 70.2% of the variance in pain interference. No other variables entered the model.

Discussion

Patient-centered outcomes research relies on measuring end-points that are important to individuals in the population of interest.[20] The COPS was intended to be an efficient, patient-centered, summative measure that captures the patient's overall experience of chronic pain and how much that pain is dominating his or her life.[19] The concept of pain centrality may be particularly useful for practicing patient-centered care and making shared decisions.[18] For example, while patients and providers may disagree on the value of focusing on pain severity as the goal of treatment, they may be able to align on the common goal of reducing how much pain is dominating a patient's life.

The COPS was initially tested with a small sample of patients who were treated in an academic internal medicine clinic.[19] Though preliminary psychometric testing of the COPS was promising, the current study provides important validation of the scale's properties in a larger sample, different setting, and included patients with mixed chronic pain diagnoses. This sample also included participants with high self-reported pain severity and mixed current use of

prescription opioid medications. Results of the analyses in the present study confirmed that the COPS had strong internal consistency. An exploratory principal components analysis identified a single factor on which all items loaded highly, adding support for the structure of the construct. As was the case in the initial validation study, COPS total score was correlated significantly with self-reported pain severity, interference, depressive symptoms, and anxiety. We also found that it was significantly correlated with other psychological constructs, including self-efficacy for managing pain, pain catastrophizing, and methods of coping with pain. COPS score was positively correlated with risk for prescription opioid misuse. These correlations add evidence of the scale's convergent and divergent validity.

Hierarchical linear regression analyses were conducted to examine variables significantly associated with pain severity and interference. In the analysis examining pain severity, pain interference was the primary variable associated with the outcome, while COPS score contributed a small but significant portion of the variance. In the analysis examining pain interference, pain severity accounted for the most substantial portion of the variance, while COPS score, chronic pain coping strategies guarding and relaxation, current prescription opioid status, and anxiety severity were also significantly associated. These analyses suggest that pain centrality as measured by the COPS may add additional clinical information not captured by other measures. Additionally, the strong correlations between the COPS and a wide array of clinical factors supports the idea that pain centrality may be used as a summative measure that captures multiple aspects of the pain experience.

Centrality of pain may also serve as a potential direct leverage point for psychological treatment. Non-pharmacological interventions for chronic pain traditionally include a focus on addressing cognitive distortions that serve to increase pain or impact function, as well as build self-efficacy for managing chronic pain.[15] Prior research indicates that pain catastrophizing and self-efficacy for managing pain can mediate chronic pain treatment outcomes.[5,7,16] Pain centrality may move in tandem with changes in clinical progress; however, it is unclear whether

improvements in pain centrality (i.e., having less focus on pain and increasing focus on other health indicators or function) lead to or derive from improvements in pain and function. Future clinical work may attempt to address pain centrality with patients and evaluate whether changes have a resulting impact on chronic pain outcomes.

The current study has several limitations, including its cross-sectional design and its use of a convenience sample. Participants were all veterans seeking care at a single VA hospital and the majority of participants were non-Hispanic White males. Additionally, all participants had been tested for the hepatitis C virus, which may result in a sample of patients with higher rates of current and past substance use disorders. Replication of study findings in other settings would increase confidence in the results. Finally, data for this study are based on responses to self-report questionnaires, which may have contributed to higher correlations between measures. Future research with the COPS may include collection of objective data and evaluate the extent to which COPS scores correlate with pain pathology. Future prospective research is also needed to assess the stability of responses to the COPS and the relationship between treatment outcomes and changes in COPS scores. The Cronbach's alpha of the COPS in this study was .90, which matched the internal consistency in the original COPS validation sample, and raises the possibility that fewer items may be needed to adequately address pain centrality; future studies may conduct analyses of an abbreviated version of the scale. The one-factor structure of the COPS should also be confirmed in another clinical sample.

Despite these limitations, the study provides important data supporting the reliability and validity of a brief (10-item) patient-centered measure intended to capture the patient's overall experience of pain and the pain's impact on his or her life. Further research is needed to assess the test-retest reliability of the COPS and psychometric characteristics in other clinical samples. Clinical research may evaluate the COPS' impact on disability, responsiveness to change over time, and whether pain centrality is an effective focus of non-pharmacological interventions for chronic pain.

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Table 1. Demographic characteristics (n=178)

	% (N) or Mean (SD)
Age	54.7 (7.7)
Male	92.1% (164)
Race	
White/Caucasian	75.8% (135)
Black/African-American	11.8% (21)
American Indian	3.9% (7)
Latino	3.9% (7)
Other	4.5% (8)
Marital Status	
Single	18.5% (33)
Married/Living with partner	25.8% (46)
Divorced or separated	50.0% (89)
Widowed	5.1% (9)
Unknown	0.6% (1)
Employment Status	
Full or part-time	16.9% (30)
Unemployed	33.1% (59)
Receiving disability	41.0% (73)
Other	9.0% (16)
Annual income < $15,000	59.6% (106)

Table 2. Descriptive statistics and Pearson correlations between the Centrality of Pain Scale and other measures of pain and mental health.

Measure	Mean (SD)	Centrality of Pain Scale	Pain Severity	Pain Interference
Centrality of Pain	28.8 (8.5)	---	0.61***	0.68***
Pain Severity	3.6 (1.3)	0.61***	---	0.73***
Pain Interference	3.9 (1.5)	0.68***	0.73***	---
Pain Catastrophizing Scale	24.1 (12.5)	0.69***	0.56***	0.61***
Chronic Pain Self-Efficacy Scale	133.9 (41.0)	-0.73***	-0.56***	-0.60***
CPCI Guarding	3.7 (1.9)	0.49***	0.43***	0.57***
CPCI Resting	3.8 (1.5)	0.24**	0.21***	0.27***
CPCI Asking for Assistance	1.8 (1.9)	0.31***	0.29***	0.34***
CPCI Relaxation	2.1 (1.4)	0.09	0.14	0.24***
CPCI Task Persistence	3.7 (1.7)	-0.34***	-0.11	-0.20**
CPCI Exercise/Stretch	2.5 (1.9)	-0.08	0.06	0.04
CPCI Coping Self-Statements	3.2 (1.9)	-0.01	0.17*	0.11
CPCI Seeking Social Support	2.2 (1.9)	0.01	0.20*	0.12
Beck Depression Inventory–II	17.8 (12.4)	0.47***	0.33***	0.45***
Generalized Anxiety Disorder Scale	8.3 (6.1)	0.37***	0.33***	0.42***
Pain Medication Questionnaire	27.0 (11.4)	0.32***	0.25***	0.29***

Note. CPCI = Chronic Pain Coping Inventory. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 3. Factor loading scores for individual Centrality of Pain Scale items.

Item*	Factor Loading
1. Pain controls my life.	.790
2. I am able to live a full life despite my pain.**	.696
3. My pain defines who I am.	.599
4. I have control over my pain most of the time.**	.611
5. I think about pain all the time.	.764
6. My pain consumes all of my energy.	.785
7. My life revolves around my pain.	.828
8. Pain is a constant struggle for me.	.808
9. I can deal with my pain.**	.586
10. Pain greatly interferes with my life.	.819

Note. * All items are rated on a 5-point Likert scale with 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree. ** Reverse scored.

Table 4. Multivariate regression analyses examining variables associated with pain severity and pain interference.

Variable	R^2	Adjusted R^2	R^2 change	F change	p-value
PAIN SEVERITY					
Step 1. Demographic variables	.029	.004	.029	1.17	0.325
Step 2. Pain Interference	.544	.529	.515	175.12	< 0.001
Step 3. Centrality of Pain	.558	.541	.014	4.92	0.028
PAIN INTERFERENCE					
Step 1. Demographic variables	.039	.014	.039	1.59	.180
Step 2. Pain Severity	.549	.534	.510	175.12	< 0.001
Step 3. Centrality of Pain	.646	.632	.097	42.11	< 0.001
Step 4. CPCI Guarding	.685	.671	.040	19.27	< 0.001
Step 5. CPCI Relaxation	.698	.682	.013	6.36	0.013
Step 6. Current opioid prescription	.710	.692	.012	6.00	0.015
Step 7. Anxiety severity	.720	.702	.011	5.78	0.017

Note. Demographic variables inserted into the model in Step 1 included age, gender, ethnicity, and income. CPCI = Chronic Pain Coping Inventory.

Psychometric Properties of the Centrality of Pain Scale

Highlights:

- Study purpose was to conduct psychometric analysis of the Centrality of Pain Scale (COPS).
- Principal components analysis revealed a single factor and all items loaded highly.
- COPS scores correlated with other measures of pain and mental health.
- COPS score was independently associated with pain severity and pain interference.
- Future research is needed to assess measure stability, psychometric characteristics in other settings, and responsiveness to change following clinical intervention.