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Clinical and Psychosocial Factors Over Time Following an Acute Low Back Pain Episode

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BACKGROUND: Low back pain (LBP) is a prevalent condition with overwhelming healthcare costs and high disability rates. Characterization of clinical and psychosocial variables over time in patients experiencing an episode of acute LBP and the identification of factors that differ between those who develop chronic LBP and those who do not could aid in the development of improved targeted treatment.

PURPOSE: The purpose of this study was to evaluate the trajectory of depression, pain catastrophizing, life purpose, pain sensitivity, and disability in persons presenting with an acute/subacute episode of LBP, evaluating whether there are changes over time and differences in these variables between those who developed chronic LBP and those who did not.

METHODS: Prospective analysis (baseline, 2.5 months, 6 months, and weekly diaries) of 42 patients experiencing an acute LBP episode was performed. Descriptive statistics, repeated-measures mixed modeling, and Fisher's least significant differences method were used during data analysis.

RESULTS: Depressive symptoms vary over time. There was no difference over time in pain catastrophizing, life purpose, pain sensitivity, or disability. Those who met the criteria for chronic LBP at 6 months had increased pain catastrophizing scores and higher disability scores compared with those who do not meet the criteria for chronic LBP. Depressive symptoms, life purpose, and pain sensitivity were not different between those who met the criteria for chronic LBP and those who did not.

CONCLUSION: Findings from this study characterize factors potentially contributory to the development of chronic LBP over time. Those participants who developed chronic LBP had higher pain catastrophizing scores averaged across all time points in this study, suggesting it could be an interesting factor to target to improve LBP chronicity.

Background

A staggering $88 billion is spent annually on the healthcare of persons with low back pain (LBP) in the United States (Dieleman et al., 2016). Contributing to these costs is the prevalence of the condition: Worldwide, 80% of the population has a lifetime experience with LBP and 23% report experiencing LBP within the past month (Dieleman et al., 2016; Hoy et al., 2012; National Institute of Neurologic Disorders and Stroke [NINDS], 2018). Of concern, LBP ranks highest in years lived with disability and ranks sixth for the overall burden of disease according the Global Burden of Disease 2010 Study, suggesting improved treatment approaches are needed (Global Burden of Disease Study 2013 Collaborators, 2015; Hoy et al., 2014; Murray et al., 2012).

Duration of symptoms is commonly used to group patients with LBP (NINDS, 2018). The duration of acute LBP is generally a few days to a few weeks. Subacute LBP lasts between 4 and 12 weeks. Patients who experience pain for greater than 12 weeks advance into the chronic LBP category. The NIH Task Force on Research Standards for Chronic Low Back Pain defines chronic LBP as "back pain that has persisted at least 3 months and has resulted in pain on at least half the days in the past 6 months (Deyo et al., 2014, p. 253). Chronic LBP rates have more than doubled in recent years (Freburger et al., 2009). It is critically important to understand factors related to the

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development of chronic LBP to prevent the overwhelming cost and disability and to support the development of improved targeted treatment approaches.

Various psychosocial (i.e., depression) and clinical factors (i.e., pain sensitivity) have been postulated to play a role in the transition of LBP to a chronic state. Although some clinical factors have significant evidence to support their role in LBP transition to a chronic pain condition, other variables such as life purpose have not been well studied. Overall, there is strong evidence suggesting that depression is a factor impacting recovery in patients with acute LBP (Gurcay et al., 2009; Melloh et al., 2013; Shaw et al., 2016; Traeger et al., 2016). Yet, Friedman et al. (2017) did not identify a role of depression on the outcome of function in the acute LBP population.

Pain catastrophizing, or the exaggerated and negative orientation of pain, has been identified as a factor affecting patients with LBP during the acute phase (Melloh et al., 2013; Swinkels-Meewisse et al., 2006; Verbunt et al., 2005). Although the preponderance of the current literature supports the role of higher pain catastrophizing in increased disability, the findings are conflicting, with some studies identifying pain catastrophizing as a factor affecting disability whereas others did not identify associations between these two factors (Friedman et al., 2017; Sieben et al., 2002). A limitation of the existing literature is that many of these studies were conducted more than a decade ago.

Only two cross-sectional studies were identified that described the variable of pain sensitivity in patients with acute LBP (Klyne et al., 2018; Starkweather et al., 2016). Persons with acute LBP were found to have increased pain sensitivity when compared with controls (Klyne et al., 2018; Starkweather et al., 2016). Although these findings offer little insight into the role of this variable in the development of LBP chronicity, they do offer a potential variable for consideration for future studies.

Although the importance of meaning in life or life purpose to improved health outcomes has been described in the medical, and specifically chronic pain, literature, we could not identify articles investigating life purpose in patients with LBP during the acute/subacute phase (Salt et al., 2016; Steptoe et al., 2015). Yet, life purpose is a component of well-being and a lack of well-being has been associated with disability in patients with acute LBP (Ryff & Keyes, 1995; Wand et al., 2010).

Given the conflicting or lack of available research in these areas, the aims of this study were to evaluate the trajectory of depression, pain catastrophizing, life purpose, pain sensitivity, and disability in persons presenting with an acute/subacute episode of LBP, evaluating whether there are changes over time and differences in these variables between those who developed chronic LBP and those who did not.

Methods

Design and Sample

This is a secondary analysis of data from a prospective study evaluating the effect of clinical, biomechanical, and psychosocial variables in patients randomized to cognitive therapy versus attention control intervention groups. In the larger study, a sample of 42 persons was recruited. These persons (1) were 18 years or older; (2) were being treated for an acute LBP (≤3 months) episode, as diagnosed by their healthcare provider; and (3) had access to a telephone. Persons who were found to have a cognitive impairment, intention to harm themselves or another, or were currently abusing substances were excluded. Participants were recruited from ambulatory care clinics (Women's Health, Family Medicine, Internal Medicine, and Urgent Treatment) and health registries (Kentucky Women's Health Registry and ResearchMatch) at a large university healthcare system (University of Kentucky, 2017; Vanderbilt University, 2017). Of note, no treatment effects were found in the randomized clinical trial.

Human Subjects Protection

This study was approved by the medical institutional review board at a large academic institution. Participants signed informed consent documents, and all research personnel completed human subject protection training. All data were collected and stored on a password-protected server with a secure firewall to ensure participant confidentiality. Paper and pencil consent forms were stored in locked file cabinets. The list of participant names was kept separate and stored in a locked file cabinet.

Data Collection

Survey measures described in the following text were self-reported using a REDCap questionnaire. Baseline data were collected from August 2015 to August 2017, and two additional follow-up surveys along with biomechanical measurements were administered at 2.5 and 6 months following the baseline assessment. Participants were also asked to complete weekly diaries in REDCap, summarizing current pain levels, location of pain, depression, pain catastrophizing, well-being, perceived functional disability, and motivation.

Measures

"Depressive symptoms" were measured using the Center for Epidemiological Studies-Depression (Radloff, 1977), a 20-item scale using a 4-point Likert response set to measure weekly frequency (0 = "rarely or less than 1 day" to 3 = "most of the time or 5–7 days"; scale score range = 0–60; Cronbach's $\alpha = .89$). While 16 of the items were phrased to suggest a greater degree of depressive affect, the four items with opposite polarity were reverse-coded before summing the items so that higher scores on the total indicated greater depressive symptoms (Radloff, 1977; Thorn et al., 2011).

"Pain catastrophizing" was defined as "an exaggerated negative mental set brought to bear by an actual/anticipated painful experience." Pain catastrophizing was measured using the Pain Catastrophizing Scale (Sullivan et al., 1995), a 13-item scale that uses a 5-point Likert scale (0 = "not at all" to 4 = "all the time"; Cronbach's $\alpha = .94$; test–retest reliability = .78) and has evidence supporting concurrent and discriminant validity. Scale items are summed, and a higher total score indicated higher pain catastrophizing (scale score

range = 0–52) (Osman et al., 1997). Cronbach's α for this sample was .92.

"Life purpose" was measured using one of the six subscales of the Scales of Psychological Well-Being: that is, growth, purpose in life, environmental mastery, autonomy, personal relations with others, and self-acceptance; 84 total items (Ryff & Keyes, 1995). The subscale, titled Purpose in Life uses a 6-point Likert-type scale (6 = "strong disagree" to 1 = "strongly agree"; Cronbach's α = .83; scale score range = 14–84; example item: "I have a sense of direction and purpose in life"); a lower score identifies persons with increased well-being (Sullivan et al., 1995).

"Pain sensitivity" was measured with pressure-pain thresholds. A handheld 1-cm² round rubber-surfaced algometer (Medoc, http://www.medoc-web.com) applied to bilateral trapezius, low back, legs, and forearms was used to conduct pressure-pain threshold testing. Participants informed a blinded assessor when the stimulus began to illicit pain. Correlations between algometer force and plate readings, which were measured in the units of kilopascals (kPa), have been reported at .99 (Grone et al., 2012; Kinser et al., 2009).

"Perceived functional disability" was defined as an individual's perception of their activity limitations caused by their pain. Functional disability was measured with the 24-item Roland–Morris Disability Scale. A strong correlation has been reported between the 11-item and 24-item versions (r = .93; Cronbach's α = .84). Participants were asked to mark responses to scale items reflecting applicable limitations. Scale items were summed; a higher total score indicated higher disability (scale score range = 0–24; example scale item: "I stay at home most of the time because of my back") (Stroud et al., 2004). Cronbach's α for this sample was .86.

"Demographic information" on age, gender, and work status was collected at baseline. Work status was classified as working full-time or not working full-time.

Data Analysis

Classification of Chronic and Nonchronic

The NIH Task Force on Research Standards for Chronic Low Back Pain definition of "chronic" LBP was used to classify participants as "chronic" or "nonchronic" groups. The task force specified that "chronic low back pain was defined as a back pain problem that has persisted at least 3 months, and has resulted in pain on at least half the days in the past 6 months" (Deyo et al., 2014). Data were collected weekly. Participants who responded with pain greater than a "0" on a scale of 0–10—to the item "Please rate your pain by selecting the one number that best describes your pain at its least in the last week"—for one data point for 3 months out of the 6 months of data collected and specified the low back to be a source of pain were classified as chronic LBP. Those who reported either no pain or painless frequently than the threshold were classified as nonchronic.

Study data were summarized using descriptive statistics, including means and standard deviations and frequency distributions. Repeated-measures mixed models including the main effects of time (baseline, 2.5 months, and 6 months) and pain group (chronic or nonchronic) and the interaction term were used to evaluate whether changes in psychosocial measures differed by group over time. In this context, the interaction between group and time is a test for whether the pain groups have a different pattern of means in the outcomes over time. The interaction term was not significant in any of the models and therefore only the models with main effects were interpreted. Post hoc analyses were conducted using Fisher's least significant differences method. These models were run using the MIXED procedure in SAS; one benefit of this strategy was the retention of participants even if they were not complete on all data points. This analysis was possible because of a lack of intervention treatment effect. All data analysis was conducted using SAS, Version 9.4, with an α level of .05 throughout.

Results

Depending on the variable, data were available for 42 participants at baseline, 27–29 participants at 2.5 months, and 22–25 participants at the 6-month assessment. The average age of the 42 participants was 53.6 years (SD = 11.2; range = 30–75 years; see Table 1), the majority were female (81%) and working full-time (55%). Half of the participants met the definition for

Table 1. Demographic and Psychosocial/Clinical Characteristics of the Study Sample at Baseline (N = 42)

	M (SD); Range or n (%)	Potential Range
Personal characteristics		
Age	53.6 (11.2); 30–75	18+
Gender		
Male	8 (19.0%)	
Female	34 (81.0%)	
Working full-time		
Yes	23 (54.8%)	
No	19 (45.2%)	
Chronic pain status[a]		
Chronic low back pain	15 (50.0%)	
Nonchronic low back pain	15 (50.0%)	
Clinical characteristics		
Depressive symptoms	8.0 (5.5); 0–22	0–60
Pain catastrophizing	13.2 (9.7); 2–41	0–52
Life purpose	69.8 (10.0); 45–84	14–84
Pain sensitivity[b]	199.2 (117.1); 22–496	0–600
Disability	7.5 (4.8); 0–24	0–24

[a]To be classified as chronic or nonchronic low back pain status, patients had to have data for 3 of the 6 months as defined by the NIH Task Force (data available for n =30).
[b]Measured in kilopascals.

Table 2. Results of Repeated-Measures Mixed Models Evaluating Changes in Psychosocial Variables Over Time and by Pain Group (*N* = 30)

	Time				Pain Group		
Outcome	Baseline	2.5 Months	6 Months	*F* (*p*)[a]	Chronic Pain	Nonchronic Pain	*F* (*p*)[a]
Depression	8.1 (1.0)[a]	14.1 (1.3)[b]	9.5 (1.2)[a]	7.3 (.002)	10.0 (0.9)	11.1 (1.0)	0.8 (.37)
Pain catastrophizing	11.9 (1.7)	10.0 (1.8)	7.9 (1.8)	1.3 (.29)	13.4 (1.5)	6.5 (1.4)	11.1 (.002)
Life purpose	71.9 (1.7)	72.6 (2.2)	75.5 (2.1)	0.9 (.40)	74.3 (1.7)	72.4 (1.5)	0.7 (.41)
Pain sensitivity (kPa)[b]	210.7 (20.1)	217.6 (21.7)	191.5 (22.1)	0.4 (.68)	214.1 (18.0)	199.0 (16.8)	0.4 (.54)
Disability	7.2 (0.8)	4.7 (0.9)	5.0 (0.9)	2.6 (.088)	7.9 (0.8)	3.4 (0.7)	19.1 (<.001)

Note. Cells contain adjusted means and standard errors; means with different (superscript) letters are significantly different in post hoc analysis: [a]A significant effect was identified between baseline and 2.5 months ($p <$. 001); [b]A significant effect was identified between 2.5 and 6 months (p = .01).
[a]*p* from Type 3 test of fixed effects.

chronic LBP (50%). At the baseline assessment, the average number of reported depressive symptoms was low (M = 8.0, SD = 5.5; out of a potential score of 60). Pain Catastrophizing subscale score was 13.2 (SD = 9.7; out of a potential score of 0–52). In general, the sample reported high life purpose scores with an average of 69.8 (SD = 10.0; out of a potential score of 14–84). The Pain Sensitivity subscale scores were highly variable. Although the average was 199.2 kPa, the range was 22–496 (SD = 117.1).

In the repeated-measures mixed models, there was a significant main effect of time for the outcome of depressive symptoms (F = 7.3, p = .002; see Table 2). Depression scores, although on the low scale, were elevated at 2.5 months (M = 14.1, SE = 1.3) when compared both to baseline (M = 8.1, SE = 1.0; $p < .001$) and to 6 months (M = 9.5, SE = 1.2; p = .01) across pain groups. The difference between baseline and 6 months was not significant. There was no difference over time in pain catastrophizing, life purpose, pain sensitivity, or disability.

Regardless of time, there was a difference in pain catastrophizing and disability between those with and without chronic LBP. On average, those with chronic LBP had higher pain catastrophizing scores than those without chronic LBP (M = 13.4, SE = 1.5 vs. M = 6.5, SE = 1.4; p = .002). Those with chronic LBP did have significantly higher disability scores than those who did not (M = 7.9, SE = 0.8 vs. M = 3.4, SE = 0.7; $p < .001$). Depressive symptoms, life purpose, and pain sensitivity were not different between those who met the criteria for chronic LBP and those who did not.

Discussion

Our findings suggest that depressive symptoms vary over time in patients who initially presented in an acute/subacute episode of LBP. We also found that those that met the criteria for chronic LBP at 6 months had increased pain catastrophizing scores and higher disability scores compared with those who do not meet the criteria for chronic LBP.

Many studies in the literature suggest that increased pain and disability in patients with LBP are associated with increased depressive symptoms (Calvo Lobo et al., 2019; Nordeman et al., 2017; Tsuji et al., 2016). In contrast, a prospective study did not find depressive symptoms to predict long-term pain-related disability (Esteve et al., 2017). These studies reported findings at one or two time points as opposed to changes in depressive symptoms over time (Calvo Lobo et al., 2019; Esteve et al., 2017). Because LBP is characterized by frequent fluctuations in symptoms, this lack of variable characterization hinders a complete understanding of the course of LBP and its relationship to potentially contributory factors such as depression (Suri et al., 2011, 2012). Thus, our study provides important insight into the fluctuations of depressive symptoms over time in patients who initially present in an acute/subacute LBP episode. Because increased pain symptoms occur in 51% of patients with LBP and because those who experience an increase in symptoms are more likely to have higher levels of functional disability, increased opioid use, and increased healthcare usage when compared with those who do not, this characterization of depressive symptoms over time provides an important contribution to the literature (Suri et al., 2012).

Our findings suggest that there was no significant change in pain catastrophizing score over time; yet, those who met the criteria for chronic LBP at 6 months had significantly higher pain catastrophizing scores than those who did not meet the chronic LBP criteria. There are conflicting findings about the role of pain catastrophizing in LBP symptoms (Sieben et al., 2002; Swinkels-Meewisse et al., 2006). Sieben et al. (2002) used a time-series design and found no time shift between pain and pain catastrophizing. Interestingly, Jellema et al. (2006) evaluated pain catastrophizing in a psychosocial intervention group and the usual care group. A lower pain catastrophizing score was found to predict a 30% improvement in the participants' perceived functional disability score: odds ratio = 0.94; 95% confidence interval [0.98, 0.99] (Jellema et al., 2006). In an additional cross-sectional study of patients with acute LBP, Swinkels-Meewisse et al. (2006) identified a relationship between pain catastrophizing, disability, and pain in patients with acute LBP. Some of this

variability might be attributed to differing definitions of acute LBP (Sieben et al., 2002; Swinkels-Meewisse et al., 2006). In our study, we were able to follow patients with LBP prospectively over time and therefore categorize patients as chronic LBP per the NIH Task Force on Research Standards for Chronic Low Back Pain definition (Deyo et al., 2014). We also found patients with chronic LBP to have increased functional disability scores compared with the nonchronic group. These findings are supported by the NIH Task Force on Research Standards for Chronic Low Back Pain, which recommends disability or function be consider in the score indicating the impact or severity of disease (Deyo et al., 2014).

Although pain catastrophizing is associated with pain sensitivity, we did not identify any significant changes in pain sensitivity over time or significant differences between the chronic and nonchronic groups (Meints et al., 2019). Although the neurological tenets of the relationship between pain catastrophizing and pain sensitivity are becoming better understood, the role of pain sensitivity in LBP requires further elucidation to advance the state of the science (Jiang et al., 2016).

Similarly, we could not identify significant changes in measures of life purpose or meaning in life over time in our sample or between the chronic and nonchronic groups. The literature suggests that improved health outcomes are associated with improved life purpose; yet, our current study could not support this claim for individuals with LBP (Salt et al., 2016; Steptoe et al., 2015).

Strengths and Limitations

The primary strengths of this study are the longitudinal nature of the design, the length of follow-up, and the relatively robust retention of participants. The primary limitation, particularly for the assessment of associations among the subgroups defined by chronic/nonchronic pain, was sample size. Although the number of subjects included in this exploratory study was similar to other studies in this area (Henchoz et al., 2013; Vaisy et al., 2015), further investigation of these relationships is needed, particularly when considering subgroup analysis. An additional limitation was the lack of detailed LBP history prior to the acute/subacute LBP episode, impacting our ability to characterize the nature of this episode beyond the requirement that a participant had to have complete relief of symptoms prior to enrollment and symptomatic for less than 3 months.

Clinical Implications

Understanding psychosocial and clinical factors that characterize chronic LBP symptoms has important clinical implications—specifically, such an understanding can facilitate the identification of high-risk groups. Following the identification of high-risk groups, tailored interventions to address the risk factors can be developed to prevent the chronicity of symptoms (i.e., pain and impaired function) in this population. In this study, we identified pain catastrophizing as an important risk factor. Identifying patients with LBP with high pain catastrophizing scores and providing evidence-based treatments to address this mind-set may prevent chronic LBP symptoms.

Conclusion

Our findings suggest that depressive symptoms vary over time in patients who initially present in an acute/subacute episode of LBP. We also found that those who met the criteria for chronic LBP at 6 months had increased pain catastrophizing scores and higher disability scores compared with those who did not meet the chronic LBP criteria. Findings from this study characterized factors that may contribute to the development of chronic LBP and identified pain catastrophizing as an important risk factor for the development of chronicity in LBP.

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