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The Role of Anticipation and Fear of Pain in the Persistence of Avoidance Behavior in Patients With Chronic Low Back Pain

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Study Design. A correlative design using stepwise regression analysis.

Objective. To explore the variation in spinal isometric strength that can be accounted for by anticipation of pain, sensory perception of pain, functional disability belief, and the fear–avoidance belief in chronic low back pain patients.

Summary of the Background Data. Several biobehavioral factors contribute to the persistence of pain behavior in chronic patients. Recent studies suggest a need to explore the relation between reduced physical performance and the sensory and cognitive perception of pain.

Methods. Sixty-three patients with chronic low back pain 20 to 56 years of age participated in this study. Visual Analogs Scales, the Fear–Avoidance Belief questionnaire, and the Disability Belief questionnaire were used to measure the sensory and cognitive dimensions of pain. Spinal isometric strength was measured by the Medx lumbar extension machine.

Results. Analysis of variance and the stepwise regression analysis demonstrated that anticipation of pain and the fear–avoidance belief about physical activity significantly predicted variation in the spinal isometric strength deficit $P < 0.001$. True pain experienced during the testing and answers to the Disability Belief questionnaire were not related.

Conclusion. The results of this study strongly support the hypothesis that spinal physical capacity in chronicity is not explained solely by the sensory perception of pain. The anticipation of pain and the fear–avoidance belief about physical activities were the strongest predictors of the variation in physical performance. [Key words: isometric strength, anticipation of pain, fear of pain, fear-avoidance belief, disability belief, sensory perception of pain] **Spine 2000;25:1126–1131**

The persistence of avoidance behavior in chronic stages of back pain beyond the expected healing time, when little or no pain or evidence of structural damage exist, is a strong challenge to the thesis that avoidance behavior is the sole indicator of the sensory perception of pain.[4,5,11,14,25,26] It is now widely recognized that pain has sensory and cognitive dimensions.[17] Fear of pain and pain avoidance behavior are two important factors that should be integrated in the clinical assessment of chronic low back pain.[3,14,25]

Several studies repeatedly have indicated that an individual's past experience with pain, the memory of that pain, and recurrent episodes of pain tend to sensitize the individual to anticipate more pain, influence the amount of fear, and greatly fortify pain–avoidance behaviors.[5,9] It is important from the psychological point of view that physical therapists be able to differentiate between functional disabilities due to sensory experience of pain and those kinds of behavior that are driven by the fear–avoidance belief.[3,5,14] A psychological model based on fear of pain has proposed that avoidance behavior itself can become out of synchronization with the sensory component of pain and organic pathology, emphasizing the role of cognition in influencing the spinal mechanics in chronic back pain patients.[14] The fear of pain, driven by the anticipation of pain and not by the sensory experience of pain, has been suggested as a strong negative reinforcement for the persistence of avoidance behavior and the alleged functional disability in chronic low back pain patients.[14,25,26]

A recent review of the biopsychosocial factors contributing to the persistent pain and pain–avoidance behavior draws attention to five sets of variables—biologic, cognitive perceptual, behavioral, environmental, and psychophysiologic factors—that may attenuate or exacerbate the discrepancy among pathology, pain, impairment, functional limitation, and disability.[3,11] There is a need to explore the relations of selected biopsychosocial factors to the clinical presentation of pain and the alleged disabilities in people with chronic low back pain. The aim of this study was twofold: to determine the maximum isometric torque of the spinal muscles in patients with chronic low back pain and to investigate the variation in spinal isometric strength that can be accounted for by the anticipation of pain, the sensory perception of pain, the functional-disability belief, and the fear–avoidance belief in chronic low back pain patients.

Clinicians mostly depend on the patient's verbal communication and behavioral presentation when assessing clinical pain. Therefore, the assumption made in this study was that patients would cooperate in rating their anticipation of pain, sensory perception of pain, disability belief, and fear—avoidance belief while honestly producing their maximal efforts in the task performance.

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Table 1. Collinearity Tolerance Test Between Biobehavioral Factors at Various Isometric Angles

Variables	0°	12°	24°	36°	48°	60°	72°
Fear avoidance belief about physical activity	0.996	0.996	0.996	0.996	0.996	0.996	0.996
Fear avoidance belief about work	0.988	0.988	0.988	0.988	0.988	0.988	0.979
Disability belief questionnaire	0.918	0.918	0.918	0.918	0.918	0.965	0.963
Anticipation of pain before isometric test	0.996	0.996	0.996	0.996	0.996	1.000	1.000
True pain felt during isometric test	0.823	0.823	0.823	0.823	0.823	0.939	0.840

Tolerance value of 0 indicates a strong collinearity between that variable and the other independent variables.

Methods

Sixty-three volunteer patients with chronic low back pain (34 men and 29 women) 20 to 56 years of age ($\xi = 36.34$ years, SD = 8.5 years) were recruited from the outpatient physical therapy clinics of hospitals in Kuwait City. Informed consent was obtained from all participants before admission to the study. Inclusion criteria were diagnosis of chronic low back pain with pain and symptoms lasting for more than 7 weeks. Criteria for exclusion were history of diabetes, cardiovascular or respiratory disorders; pain in areas other than the lower back; neurologic conditions or symptoms affecting muscle strength; patients receiving systemic steroids or skeletal muscle relaxants, anticoagulants, or drugs for psychological illness; and female patients who were menstruating at the time of testing. Also excluded from the study were patients with spondylolysis, spondylolisthesis, osteoporosis, recent spinal fracture or surgery, spinal infections, and spinal tumors.

Instrumentation

Visual Analog Scale. The study used two independent Visual Analog Scales (VASs). Each VAS is composed of a 100-mm horizontal line. One VAS was designed to measure the anticipation of pain before the isometric strength test. Another VAS was used to measure the actual intensity of pain experienced during the isometric strength test. A number of researchers have used the VAS to measure multiple dimensions of pain, such as intensity, distress, and pain anticipation, and have found it to be a highly reliable and valid scale.[9,20,21]

Fear–Avoidance Belief Questionnaire. The individual's fear of pain associated with physical activities was measured by the Fear–Avoidance Belief Questionnaire (FABQ).[26] A precise Arabic translated version of the FABQ was presented to each participant. The FABQ has two sections with a total of 16 statements presented on the same sheet. The first section, or FABQ1, assesses the fear–avoidance beliefs about physical activity; the second section, the FABQ2, assesses the fear–avoidance belief about work. The score of each section was used independently in the statistical analysis.[26] Waddel et al[26] have reported the high reliability and validity of the FABQ when used with chronic low back pain patients.

Disability Belief Questionnaire. The participants' disability belief was measured using the Disability Belief Questionnaire (DBQ).[22] A precise Arabic translated version of the DBQ was presented to each participant. The questionnaire instructs the participant to choose from a wide range of statements that reflect on many daily living activities that may be affected by the self-held disability belief because of pain and therefore avoided by the patient.[22] The DBQ has high test–retest reliability (ICC = 0.91 in < 2 weeks, r = 0.83 in 3 weeks) and its construct validity indicates agreement with the sickness impact profile (SIP; r = 0.85), the Oswestry pain rating questionnaire (r = 0.59, 0.89, 0.78), the patients' self-rating of pain (r = 0.42), and the VAS (r = 0.59).[12]

Spinal Isometric Strength. The Medx (Ocala, FL) lumbar extension machine was used to measure the isometric torque of the back muscles through a full range of spinal motion. The Medx has been found to be reliable and valid when used on normal individuals and on patients with chronic low back pain.[6,7,23]

Procedures of Data Collection

Measuring the Fear–Avoidance Belief Questionnaire, Disability Belief Questionnaire, and Anticipated Pain. On successful completion of the medical screening, height and weight were recorded for each participant. The participants then were instructed to sit and reflect on the current state of their fear of pain and disability belief due to back pain using the FABQ and the DBQ. Participants then were seated in the lumbar extension machine with their knees positioned so that their thighs were parallel to the seat and their feet were resting on a footpad. The strapping and the procedure of determining the maximal isometric torque was explained thoroughly to each participant before testing. The Medx strapping and testing protocols have been described in detail and validated elsewhere.[2,6,7] Before starting the isometric strength test, the participant was instructed to reflect on the anticipation of pain using the VAS. The participant was instructed to mark a point on the VAS that described the anticipated back pain when performing the isometric strength test.

Measurements of Spinal Isometric Strength Capacity. The test protocol includes measurements of maximal voluntary isometric contraction of the lumbar extensor muscles at 0, 12, 24, 36, 48, 60, and 72° of lumbar flexion.[2,6,7] The test begins with the participant flexing the lumbar spine to 72°, or as far as the spine can flex. The tester then locks the participant in this position. The participant then is instructed to gradually build up the muscle tension during 2 to 3 seconds. As maximum tension is achieved, the participant is instructed to maintain the tension for an additional 1 second and to slowly release the tension through another 3 seconds. The maximal isometric

Table 2. Participants' Demographic Information

Variable	Mean	SD
Age (yr)	36.35	8.45
Height (cm)	166.70	2.15
Weight (kg)	79.30	10.73
Pain duration (mo)	10.33	7.24

Table 3. Descriptive Statistics of Lumbar Isometric Torque (ft/lb) of Patients With Chronic Low Back Pain

Sex	0°	12°	24°	36°	48°	60°	72°
Male (N = 34)	116.59 ± 68.09	135.94 ± 65.91	147.71 ± 60.74	150.26 ± 58.39	157.47 ± 59.46	155.53 ± 50.64	164.61 ± 63.05
Female (N = 29)	80.72 ± 41.30	98.48 ± 42.83	107.41 ± 45.10	113.28 ± 50.81	123.28 ± 50.79	130.81 ± 62.93	146.60 ± 37.56
Total (N = 63)	100.74 ± 59.69	118.70 ± 59.12	129.16 ± 57.38	133.24 ± 57.67	141.73 ± 61.11	147.05 ± 57.07	163.76 ± 58.43

torque generated is measured with a load cell attached to the movement arm of the machine and displayed on a computer screen in front of the participant as concurrent visual feedback. All participants were encouraged verbally during the test to give their maximum effort at each tested angle. During the test, the participants were instructed to breathe normally and to maintain a light grasp on the handles. The procedure was repeated at the subsequent angles throughout the arc of motion. A 10-second rest interval was given after each isometric test performed on a given angle. Immediately after the strength test, while the participant was still sitting on the lumbar extension machine and after release of the straps, the participant was instructed to reflect honestly on the intensity of pain experienced during the performance of the isometric test using the VAS, by marking a point on the VAS that best described the intensity of the back pain experienced during the isometric strength test.

Data Analysis. Data analysis was conducted using the SPSS statistical software program. Descriptive statistics, correlation coefficients, and stepwise regression analyses were used in the data analysis. Pearson product moment correlation coefficients were computed to determine the relation between the variables before the regression analysis. To avoid multicollinearity among predictors, a collinearity diagnostics procedure was computed for all the independent variables before regression analysis. The analysis of the collinearity tolerance test showed that none of the tolerance values were close to zero, and the tolerance values ranged from 0.726 to 1.00, indicating no collinearity among the investigated variables (Table 1). The principal component extraction method was used to reduce the scores of the isometric torque's obtained on six spinal angles (0–60°). The result of the factor analysis yields one factor score that represents the isometric torque's at these angles. This extracted factor score then was used as a dependent variable in the regression analysis. Because only 37 participants were able to perform the isometric testing at 72° of spinal flexion, the isometric scores obtained at this angle were used separately in the regression analysis. The tolerance was set at a probability level of 0.05.

■ Results

Descriptive statistics for the participants' demographic information are displayed in Table 2. The mean and standard deviations for the isometric torques of the back muscles for men and women appear in Table 3. The results show that both men and women experienced their highest isometric torques at 72° of spinal flexion (164.6 ± 63.1 and 146 ± 37.6, respectively). The isometric torques at 60° of spinal flexion were 155.5 ± 130.8 and 130.8 ± 63 for men and women, respectively. The minimal isometric torque for all participants was registered at 0° of spinal flexion; the mean and standard deviations for men and women were 116.6 ± 68.1 and 80.7 ± 41.3, respectively. At all tested angles, isometric torques increased linearly with an increase in the spinal flexion range of motion.

Table 4 displays the absolute isometric strength deficit among the participants as compared with the previously reported norms using the Medx equipment.[2] The strength deficits among men 20 to 35 years of age ranged from 40% to 55%, whereas the strength deficits among men 36 to 56 years of age ranged from 10% to 46%. The strength deficit among women ranged from 4% to 18%

Table 4. Descriptive Statistics of the Lumbar Isometric Torque (ft/lb) of Patients With Chronic Low Back Pain and Percent Strength Deficit From the Norms

Sex	Age Groups (yr)	0°	12°	24°	36°	48°	60°	72°
Male total (N = 34)	20–35	102.14 ± 69 40%*	129.36 ± 71 42%*	130.79 ± 67 50%*	131.21 ± 67 50%*	130.21 ± 63 54%*	129.21 ± 42 57%*	149.75 ± 48 55%* n = 8
	36–56	126.70 ± 67 10%*	140.55 ± 63 31%*	159.55 ± 55 32%*	163.60 ± 49 36%*	176.55 ± 50 38%*	174.00 ± 49 43%*	173.00 ± 70 46%* n = 15
Male total (N = 29)	20–35	93.09 ± 51 4%*	101.18 ± 51 18%*	113.45 ± 53 16.5%*	119.90 ± 55 16%*	131.45 ± 63 12.5%*	130.82 ± 63 20%*	146.00 ± 38 18%* n = 5
	36–56	73.26 ± 34 17%*	96.83 ± 38 20%*	103.72 ± 41 23%*	109.22 ± 49 24%*	118.28 ± 57 21%*	123.44 ± 61 24%*	171.44 ± 59 — n = 9

* Deficit from normal values.

Table 5. Descriptive Statistics of the Biobehavioral Factors

Biobehavior Factors	Mean	SD
Disability belief questionnaire (DBQ)	16.6	7.0
Fear avoidance belief about physical activities (FABQ1)	21.3	3.1
Fear avoidance belief about work (FABQ2)	30.7	9.8
Pain felt before isometric test	84.8	11.6
Pain felt during isometric test	57.5	10.4

for women 20 to 35 years of age and from 17% to 24% for women 36 to 56 years of age. At 72°, nine women showed no strength deficit as compared with the norm of the same age.[2] Descriptive statistics of the biobehavioral factors appear in Table 5. The mean and standard deviation for DBQ, FABQ1, and FABQ2 were 16.7 ± 7.0, 21.3 ± 3.0, and 30.7 ± 9.8, respectively. Descriptive statistics for the anticipation of pain and the true pain experienced during the isometric strength tests were 84.1 ± 11.6 and 57.5 ± 19.5, respectively.

Table 6 displays the results of the Pearson Product correlation coefficients. The maximal spinal isometric torque at all tested angles was inversely related to anticipation of pain. The correlation values ranged from $r = -0.38$ to $r = -0.52$ ($P < 0.05$ to $P < 0.01$). The FABQ1 was inversely related to isometric muscle strength at 0, 12, 24, 36, and 48° of spinal flexion ($r = -0.33$ to $r = -0.43$), and was significant at $P < 0.01$. The true pain experienced during the performance of the isometric test was inversely related to the isometric torques at angle 0–36° and at 60°. In contrast, they were not related at 48° or 72° of spinal flexion ($r = -0.33$ to $r = -0.3$, $P < 0.05$). The DBQ showed no correlation with the spinal isometric torques at any angle.

The results of the stepwise regression analyses (Table 7) showed that the anticipation of pain and the FABQ1 were the best predictors for the variation in participants' maximal isometric torque. The results of the analysis of variance (Table 8) demonstrated that the anticipation of pain and the FABQ1 could significantly predict variation in the maximal isometric torque of the back muscles ($P < 0.02–0.000$) for angles 0 to 60° and 72°, respectively.

■ Discussion

The results of this study strongly support the hypothesis that avoidance behavior in chronicity is not explained solely by the sensory perception of pain. The result of the isometric strength test clearly demonstrated the existence of significant strength deficit in the spinal muscles in patients with chronic low back pain as compared with the previously reported norms for healthy individuals of the same age and gender.[2] There is no doubt that the strength deficit was associated with chronic and often impaired spinal function, but the cause-and-effect relation between muscle weakness and chronic low back pain has not been confirmed.[1,8,10,18,19,24] The results of the stepwise regression analysis and the analysis of variance (Tables 7 and 8) showed that cognitive–perceptual processes such as the anticipation of pain and the fear–avoidance belief about physical activity were the most significant predictors of the spinal strength deficit. The physiologic sensory perception of pain and the self-held disability belief were excluded from the regression equation.

The results of the present study corresponded well with previous study results that demonstrated generalized weakness of trunk muscles, hypothesizing that trunk muscle weakness is due to disuse caused by muscle guarding imposed by anticipation or fear of pain.[2,18,25] Other studies have negated the structural correlations between the status of the spinal muscle weakness and the prevalence of back pain.[13,18,19,24] Recently, Vlaeyen et al[25] showed that the fear of movement reinjury is the best predictor of the patient's self-reported disability among chronic back pain patients ($r = 0.49$, $P < 0.01$) and that physiologic sensory perception of pain as measured by VAS and biomedical findings did not add any predictive values.[25] Fear of pain and the anticipation of pain are cognitive–perceptual processes that can exert a significant impact on the level of function and pain tolerance.[3,11] Our results showed that anticipation of pain and the fear–avoidance belief about physical activity had a significant inverse relation to isometric strength tested at all angles ($P < 0.05–0.01$; Table 6). The variation in spinal strength that can be explained by anticipation of pain alone ranged from 14% to 23% ($P < 0.01$; Table 7). The fear–avoidance belief about physical activity explained an additional 12% of variance at various tested angles (Table 7).

Moreover, the effect of the fear vanished as the patients moved into a more flexed position in the spinal range, such as at 72° compared with the other angles, which may explain why patients with low back pain tend

Table 6. Relationships of Biobehavioral Factors to Lumbar Isometric Strength at Different Angles

Variables	0°	12°	24°	36°	48°	60°	72°
Anticipation of pain before isometric test	−0.520†	−0.429†	−0.456†	−0.448†	−0.416†	−0.416†	−0.381*
Pain felt during isometric test	−0.295*	−0.281*	−0.250*	−0.254*	−0.242	−0.325†	−0.216
Fear avoidance belief about physical activity	−0.429†	−0.365†	−0.331†	−0.341†	−0.386†	−0.241	−0.025
Fear avoidance belief about work	−0.137	−0.050	−0.039	−0.024	−0.026	−0.057	−0.222
Disability belief questionnaire	−0.143	−0.035	−0.011	−0.011	−0.003	−0.003	−0.134

* $P < 0.05$.
† $P < 0.01$.

Table 7. Summary of Final Stepwise Regression Analysis Predicting Variation in Lumbar Isometric Strength

Angles	Predictors	Multiple Correlation (R)	R^2	R^2 Change
(0°–60°) *factor score	(Constant), anticipation of pain before isometric testing	0.479	0.23	—
	Fear avoidance belief about physical activity	0.589	0.347	0.12
72°	(Constant), anticipation of pain before isometric testing	0.381	0.145	—

* Factor score extracted by the principal component analysis method for angles 0°–60°.

to avoid end-range extension, as in most derangements and extension dysfunction syndromes.[15]

People with back pain usually believe that physical activity or work could increase their pain and suffering. Waddle et al[26] showed very little relation between fear–avoidance beliefs and pain itself and that fear–avoidance beliefs about work were more powerful predictors for disability in activities of daily living and work loss than fear–avoidance beliefs about physical activity.[16] On the contrary, our results showed that fear–avoidance belief about physical activity was a better predictor for the variation in the spinal isometric strength than the fear–avoidance belief about work. Fear–avoidance belief about work is likely to be profoundly affected by work-related injuries and type of work, and therefore, directly related to work-loss or work-related compensation.[26] Although in this study the majority of the participants were actually working, they neither had work-related injuries nor had filed work compensation claims for their injuries. This may explain the lack of the relation to the fear–avoidance belief about work. Additionally, most of the participants of this study did not do heavy manual work in nature, and their work did not aggravate the participants' pain or symptoms or their fear of work. This may explain the lack of fear about work relations with the dependent factors.

Table 8. Analysis of Variance for Predicting Variation in the Lumbar Isometric Strength in Chronic Low Back Pain Patients at Various Angles

Isometric Strength at:	Source	df	SS†	MS‡	F	*P*
(0–60°)	Regression	2	21.527	10.763	15.956	0.000‖
*factor	Residual	60	40.473	0.675		
score	Total	62	62.000			
	Regression	1	17804.3	17804.330	5.929	0.020§
72°	Residual	35	105094.5	3002.699		
	Total	36	122898.8			

* Factor score extracted by the principal component analysis method for angles 0–60°.
† Sum of square.
‡ Means of square.
§ $P < 0.05$.
‖ $P < 0.000$.

■ Key Points

- The cognitive perception of pain, the anticipation of pain, and the fear–avoidance belief about physical activities were the strongest predictors of the isometric strength deficit in chronic low back pain patients.
- The magnitude of the relation between the isometric strength deficit and the selected biobehavioral factors was greater for the anticipation of pain than for the fear–avoidance belief about physical activities.
- The intensity of true pain experienced during the isometric strength test and the self-reported disability belief were not related to the spinal strength deficit.
- Anticipation of pain and the fear–avoidance belief may be the key to understanding the persistence of physical disability in chronic stages of low back pain.

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