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ORIGINAL RESEARCH ARTICLE

The Contribution of Previous Episodes of Pain, Pain Intensity, Physical Impairment, and Pain-Related Fear to Disability in Patients with Chronic Mechanical Neck Pain

ABSTRACT

Saavedra-Hernández M, Castro-Sánchez AM, Cuesta-Vargas AI, Cleland JA, Fernández-de-las-Peñas C, Arroyo-Morales M: The contribution of previous episodes of pain, pain intensity, physical impairment, and pain-related fear to disability in patients with chronic mechanical neck pain. *Am J Phys Med Rehabil* 2012;91:1070–1076.

Objective: The influence of physical and psychosocial variables on self-rated disability in patients with chronic mechanical neck pain has not been fully determined. This study examined the relationship of pain, physical impairment, and pain-related fear to disability in individuals with chronic mechanical neck pain.

Design: A cross-sectional study was conducted. Ninety-seven ($n = 97$) subjects (28 men, 69 women; mean age, 39.3 yrs) with chronic mechanical neck pain were prospectively recruited. Demographic information, duration of pain symptoms, pain intensity, pain-related fear, and cervical range of motion were collected on all subjects. Self-reported disability was measured with the Neck Disability Index. Correlation and regression analyses were performed to determine the association among the variables and to determine the proportions of explained variance in disability.

Results: Significant positive correlations existed between disability and previous history of neck pain ($r = 0.45$; $P < 0.001$), disability and pain intensity ($r = 0.32$, $P = 0.01$), and disability and kinesiophobia ($r = 0.23$, $P = 0.02$). In addition, a significant negative correlation existed between disability and cervical extension range of motion ($r = -0.18$, $P = 0.04$). Stepwise regression analyses revealed that previous neck pain episodes, intensity of neck pain, kinesiophobia, and cervical extension range of motion were significant predictors of disability ($r^2 = 0.400$; r^2 adjusted = 0.372; $F = 14.64$; $P < 0.001$).

Conclusions: This study found that previous episodes of neck pain, pain intensity, pain-related fear, and cervical extension range of motion explained 37.2% of the variability of self-report disability. Future longitudinal studies will help to determine the clinical implications of these findings.

Key Words: Neck Pain, Disability, Range of Motion, Kinesiophobia

Neck pain is a common problem that most people experience at some point in their life. Most cases seem to run a chronic-episodic course, with remission at 1 yr ranging from 33% to 65%.¹ Neck pain and its related disability have a huge impact on individuals, their families, communities, health care systems, and the economy.^{2,3} The point prevalence of neck pain in the general population in high-income countries has been reported to be 27.2% in women and 17.4% in men, whereas in low- and middle-income countries, the mean has been shown to be 17.5%.¹ Neck pain results in limitations when performing work, recreational, social, and familial activities in 5% of the patients.⁴ A better understanding of physical and psychologic impairments associated with neck-related disability can potentially assist clinicians in determining adequate therapeutic programs for this group of patients.

Previous research has shown that different demographic and socioeconomic factors such as sex or age have prognostic value in patients with neck pain.⁴ It is also plausible that the clinical characteristics of neck pain, for example, intensity, duration of symptoms, or number of previous episodes, also have an influence on the prognosis of patients with neck pain.⁵⁻⁷ The potential influence of these factors warrants further investigation.

The fear-avoidance model explains that avoidance of pain and painful activities because of fear leads to physical and psychologic consequences in patients with pain.⁸ Research has demonstrated that the fear-avoidance model can be applied to patients with neck pain.^{9,10} Chronic pain could produce hypervigilance, which perpetuates a vicious cycle.¹¹ Howell et al.¹² have recently examined the fear-avoidance model in a cohort of individuals with neck pain. In that study, self-rated disability in patients with chronic neck pain was found to be correlated with fear-avoidance beliefs and with cervical spine range of motion (ROM). However, the small sample size ($n = 35$) does not allow for determining a definitive model relative to the potential implications of these variables in neck-related disability.

It has been reported that neck pain has also been associated with alteration in spinal movements including reduced rotation, extension, and retraction, as compared with healthy people.¹³ A decrease in cervical rotation has been confirmed in a group of female office workers with neck pain.¹⁴ Other studies have added different outcomes and aspects of cervical mobility¹⁵ or increased coupling motion.¹⁶ A negative correlation between a reduction in cervical ROM and disability has been proposed.¹³

However, the contribution of decreased cervical ROM in neck-related disability has not been previously studied.

Pain-related fear and reduced cervical ROM are potentially modifiable risk factors of the development of chronic disability in patients with neck pain. For this reason, the purpose of the current study was to examine the relationship of pain-related fear, pain intensity, and cervical ROM to disability-related chronic mechanical neck pain in an outpatient orthopedic rehabilitation population.

METHODS

Participants

A cross-sectional design was used in the current study. One hundred forty-seven patients from the Cervical Pain Clinic Study at the University of Almería, Spain, agreed to participate. Eligible participants had to present with a report of neck pain of more than 3 mos provoked by neck postures, neck movement, or palpation of the neck musculature. The exclusion criteria were as follows: (1) history of cervical surgery or whiplash injury, (2) medical diagnosis of cervical radiculopathy or myelopathy, (3) diagnosis of fibromyalgia, and (4) evidence of central nervous system involvement and signs consistent with nerve root compression. All subjects read and signed a consent form, and this study was approved by the ethics board of the Universidad de Almería.

Data Collection

The eligible participants were first contacted by telephone after a local advertisement at the university, and those who agreed to participate were scheduled for the initial testing appointment. Upon arrival, the subjects received a complete explanation of the study protocol and signed the consent form. Demographic and clinical characteristics were self-reported. If the clinical and self-reported data were not consistent, the authors gave precedence to the clinical data.

Measurements

The Numeric Pain Rating Scale (NPRS; range, 0, no pain, to 10, maximum pain) was used to assess the mean spontaneous neck pain intensity. The NPRS has been shown to be a reliable and valid method for pain assessment.¹⁷

The Neck Disability Index (NDI) consists of ten questions measured on a 6-point scale (0, no disability; 5, full disability).¹⁸ The numeric score for each item is summed for a total score varying from

0 to 50, in which higher scores reflect greater disability. The NDI has been shown to be a reliable and valid self-assessment of disability in individuals with neck pain.¹⁹

Finally, the authors used the 17-item Tampa Scale of Kinesiophobia (TSK), which assesses fear of movement or fear of injury or reinjury.²⁰ Individuals rate each item on a 4-point Likert scale, with scoring alternatives ranging from “strongly disagree” to “strongly agree.” The test-retest reliability for the TSK has been shown to be high.²⁰

The clinical history included questions regarding the onset, nature, and location of the symptoms; the aggravating and relieving factors; and previous history of neck pain. A physical therapist with more than 15 years of experience in the management of patients with neck pain assessed the cervical ROM using a cervical ROM goniometer, which has been shown to exhibit intratester reliability between 0.87 and 0.96 in individuals with neck pain.²¹

Statistical Analysis

Means and standard deviations were calculated to describe the sample. Pearson product correlation coefficients were calculated to determine the relationships between the dependent measure (disability) and the following independent variables: age, sex, previous episodes, days from symptoms onset, perceived pain, kinesiophobia, cervical ROM, and body mass index. Similar analyses were used to examine the relationships among the independent variables to check for multicollinearity and shared variance between the measures.

A regression model was used to determine the independent variables that contributed significantly to the variance in self-rated disability. A hierarchical regression analysis examined the proportions of explained variance in the NDI score. To analyze the unique contribution of pain-related fear to function beyond demographics, intensity of pain, and impairment measures, the independent variables were entered into the regression model in four steps. The presence of previous episodes variable was entered into the model at the first step, followed by pain intensity (step 2) and extension ROM (step 3). Finally, kinesiophobia (TSK-17 score) was added in the fourth step. Changes in R^2 were reported after each step of the regression model to determine the influence of additional variables. Last, the variables that significantly contributed to neck disability were selected for inclusion in a parsimonious final regression model. The significance criterion of the

critical F value for entry into the regression equation was set at $P < 0.05$. All analyses were performed using IBM SPSS Statistics 19.0.

RESULTS

Demographic data and the mean impairment and outcome measure scores are listed in Table 1. Twenty-three patients were excluded for presenting with symptoms less than 3 mos in duration. Twenty-seven participants declined to participate. Finally, 28 men and 69 women were included in the study. The mean age of the sample was 40 yrs (range, 19–59 yrs). Seventy-two (74.2%) patients presented with three to five previous episodes of neck pain, 16 (16.5%) patients presented with five to ten previous episodes of neck pain, and 9 (9.3%) patients presented with more than ten previous episodes of neck pain.

Correlational Analyses

Significant positive correlations existed between disability and previous history of neck pain ($r = 0.45$; $P < 0.001$), disability and pain ($r = 0.32$, $P = 0.001$), and disability and kinesiophobia ($r = 0.23$, $P = 0.020$): the higher the number of previous episodes of neck pain, the higher the intensity of pain or the higher the kinesiophobia, the greater the self-rated disability. Furthermore, a significant negative correlation between disability and extension cervical ROM ($r = -0.18$, $P = 0.045$) was also found: the lower the cervical extension, the greater the disability.

In addition, significant correlations existed among the independent variables ($r = -0.19 < r < 0.59$; Table 2), but none were considered to be

TABLE 1 Demographics and baseline variable scores

	Mean (95% CI)	SD
Age, yrs	39.3 (37.5–41.0)	8.6
Body mass index, kg/m ²	24.2 (23.2–25.0)	4.1
NPRS, 0-10	5.4 (5.0–5.7)	1.7
TSK-11, 11–44	25.4 (24.1–26.8)	6.5
NDI, 0–50	15.2 (14.0–16.1)	5.1
ROM, degrees		
Neck flexion	53.1 (50.9–55.9)	10.8
Neck extension	50.1 (47.7–52.5)	11.8
Neck right side flexion	38.8 (37.1–40.5)	8.3
Neck left side flexion	38.9 (37.7–40.2)	5.9
Neck right rotation	69.5 (67.2–71.72)	11.2
Neck left rotation	71.8 (69.5–74.1)	11.2

CI, confidence interval.

TABLE 2 Pearson product moment correlation matrix for the study variables

Variable	NDI	NPRS	TSK	ROM Flexion	ROM Extension	ROM Side Right	ROM Side Left	ROM Rotation Right	ROM Rotation Left	Sex	Age	BMI	Previous Episodes
NDI	1.00												
NPRS	0.327 ^a	1.00											
TSK	0.238 ^a	0.164	1.00										
ROM flexion	0.096	0.190 ^a	0.101	1.00									
ROM extension	-0.179 ^a	-0.021	-0.086	0.081	1.00								
ROM side right	-0.045	-0.064	0.092	0.409 ^a	0.432 ^b	1.00							
ROM side left	-0.010	0.119	-0.004	0.324 ^b	0.478 ^b	0.324 ^b	1.00						
ROM rotation right	-0.046	0.052	-0.003	0.251 ^a	0.159	0.376 ^b	0.268 ^b	1.00					
ROM rotation left	-0.101	0.105	0.009	0.313 ^a	0.137	0.303 ^b	0.303 ^b	0.381 ^b	1.00				
Sex	0.068	0.017	-0.081	-0.071	0.005	-0.035	-0.018	0.089	0.173	1.00			
Age	0.153	-0.074	0.052	-0.053	0.001	-0.216 ^a	-0.162	-0.259 ^a	-0.019	0.034	1.00		
BMI	0.001	-0.103	-0.081	-0.081	-0.102	-0.064	-0.013	0.064	-0.011	-0.139	0.391 ^b	1.00	
Previous episodes	0.457 ^b	-0.042	-0.022	0.072	0.013	-0.057	-0.109	-0.016	0.020	0.078	-0.045	0.045	1.00

^a $P < 0.05$.

^b $P < 0.01$.

BMI, body mass index.

multicollinear (defined as $r > 0.80$); therefore, each variable was included in the regression analyses.

Regression Analyses

The results of the alternate hierarchical regression analysis are shown in Table 3. The presence of previous episodes of neck pain contributed approximately 20% ($P < 0.001$) of the variance in lower disability scores. Pain intensity contributed an additional 11.4% ($P < 0.001$) of the variance. The TSK-17 scores contributed an additional 3.5% ($P < 0.001$); and extension cervical ROM, 2.3% ($P < 0.01$), after accounting for the presence of previous episodes of neck pain.

The stepwise regression analyses revealed that previous neck pain episodes, intensity of neck pain, kinesiophobia, and cervical extension ROM were significant predictors of disability, and, when combined, these explained 37.2% of the variance in the self-perceived disability scores ($r^2 = 0.400$; r^2 adjusted = 0.372; $F = 14.64$; $P < 0.001$; Table 4).

DISCUSSION

The objective of the current study was to investigate the relationships between disability and clinical characteristics including cervical ROM, pain intensity, and kinesiophobia in patients with chronic mechanical neck pain. The sample of participants in this study exhibited a moderate intensity of pain²² and disability¹⁸; a moderate level of kinesiophobia²³; and reduced ROM in flexion, extension, and side bending of the cervical spine.²⁴ In the sample of this study, 98.3% of patients with neck pain reported moderate disability, following the criteria previously reported by Vernon and Mior.¹⁸ Similar levels of disability have been reported in a previous study.²⁵

Significant low to moderate positive associations were found between disability, presence of

TABLE 3 Model summary for the alternate hierarchical regression analysis, with the NDI as the dependent variable

Model	R ²	Adjusted R ²	F	P
1 ^a	0.209	0.200	24.505	<0.001
2 ^b	0.329	0.314	22.274	<0.001
3 ^c	0.371	0.349	17.472	<0.001

^aPredictors: constant and previous episodes.

^bPredictors: constant, previous episodes, and pain intensity.

^cPredictors: constant, previous episodes, pain intensity, and kinesiophobia.

TABLE 4 Summary of the stepwise regression analyses to determine the predictors of disability, $r^2 = 37.2\%$

Independent Variable	β	95% CI	<i>t</i>	<i>P</i>
Intercept	16.07	10.92, 21.22	6.20	<0.001
Previous neck pain episodes ^a	1.82	1.18, 2.46	5.64	<0.001
Perceived pain	0.99	0.47, 1.52	3.79	<0.001
TSK	0.14	0.02, 0.27	2.33	0.022
Extension cervical ROM	-0.05	-0.13, -0.02	-2.06	0.042

^aPrevious neck pain episodes coded as 0, no previous episodes; 1, one to three previous episodes; 2, three to ten episodes; 4, more than ten episodes.

previous episodes of neck pain, intensity of current neck pain, and also kinesiophobia; and a negative association, between disability and cervical extension. In fact, the results from the regression analyses showed that presence of previous neck pain episodes, pain intensity, kinesiophobia, and cervical extension ROM were significant predictors of neck pain disability. The authors found that age, sex, and duration of symptoms did not influence neck-related disability, which is similar to studies conducted in patients with chronic whiplash-associated disorders²⁶ and neck pain.²⁵

The findings of this study also support an association between the presence of previous pain episodes and neck pain disability.^{7,27-29} An increase of 5.5 points in the NDI score could be associated with an increase in the previous number of cervical pain episodes (one to three previous episodes *vs.* more than ten episodes) in patients with a similar level of perceived pain, extension ROM, and kinesiophobia. Furthermore, Bot et al.⁷ identified that patients who reported a previous episode of neck pain at baseline were significantly more likely to still be experiencing pain at a 3-month and a 12-month follow-up period. The authors also found that cervical ROM may also influence neck disability, similar to the findings of others.^{30,31}

The sample of participants in this study showed a reduction of 17% in the extension ROM as compared with normal values (ROM 9 degrees lower than the normal ROM of 60 degrees following the American Medical Association guideline).³² A small decrease of 0.25 points in the NDI score could be associated with a reduction of 5 degrees in the cervical extension ROM in patients with the same number of previous pain episodes and a similar level of perceived pain and kinesiophobia. It is plausible that a history of repeated episodes of neck pain and reduced cervical ROM could be indicative of lack of recovery from previous bouts of neck pain as well as from the persistent nature of mechanical neck pain. Methods to prevent this clinical presentation

from progressing to chronicity in patients require further attention in the literature.

The results of this study further support that fear-avoidance attitudes had a reduced influence (19.6% of explained variability following the presented explicative model) in current self-ratings of neck pain disability in patients with chronic mechanical neck pain, which is similar to the findings in patients with whiplash.^{26,31} The results of this study are in line with previously published studies confirming that fear of movement was independently associated with pain intensity, disability, and physical health in a population of patients with lumbar and cervical pain with degenerative or chronic conditions.³³⁻³⁵ This suggests that it may be essential for clinicians to understand the importance of these psychosocial issues when treating patients with both acute and chronic neck pain.³⁶ The fear of movement model suggests that pain could be perceived as threatening after several previous episodes and could potentially promote psychologic distress and give rise to pain-related fear of movement. This fear can lead to avoidance behaviors and a “disuse,” which could affect more the low demands section of ROM as cervical extension. Disuse is associated with deconditioning, which subsequently increases avoidance behaviors and perpetuates the pain process.³³ It is possible that if fear-avoidance attitudes are identified in the acute stage and managed accordingly, it could prevent the development of chronic symptoms. However, this hypothesis requires further investigation.

The results of the current study provide preliminary support that the biopsychosocial model, which recognizes that individuals exhibit a combination of somatic and psychologic factors influenced by social context, may be beneficial in the management of patients with neck-related disability.^{37,38} The identification of patients at risk for prolonged disability may allow for appropriate management strategies and may potentially enhance the outcomes.

There are a number of limitations that should be recognized. First, the authors used a cross-sectional design. In fact, because of the sample size, the number of independent variables included in the regression analysis was limited to reduce the likelihood of type II error. Further, because of the cross-sectional study design, cause-and-effect relationships between those variables associated with prolonged disability cannot be inferred. Second, because all patients were from an outpatient orthopedic rehabilitation population, extrapolation of the current results to the general population should be considered with caution. Finally, other potential variables, such as sleep disturbances,³⁹ and psychosocial and physical variables such as neck muscle strength were not included in this study, which could give a broader vision of the biopsychosocial model approach.

In summary, the current study examined the influence of some factors such as cervical ROM, as well as the role of pain-related fear and different clinical variables on self-reported disability in individuals with chronic mechanical neck pain. Previous episodes of symptoms, pain intensity, pain-related fear, and cervical extension ROM explained 37% of the variability of self-report disability. Future longitudinal studies will help to determine the clinical implications of these findings.⁷

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