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Predictors of a Favorable Outcome in Patients Treated by Chiropractors for Neck Pain

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Study Design. Prospective, multicenter, cohort study.

Objective. To examine which clinical and sociodemographic baseline variables can predict a favorable outcome in subjects with neck pain treated by chiropractors.

Summary of Background Data. Relatively little is known on predictors of neck pain, particularly for those subjects undergoing chiropractic care. No previous study has examined predictors of outcome for subjects with neck pain by modeling the trajectories of subjects in a longitudinal design.

Methods. All new, consecutive patients, between 18 and 65 years of age with neck pain of any duration, who had not undergone chiropractic or manual therapy in the prior 3 months, were recruited. Questionnaires were administered at the first 3 visits, and at 3 and 12 months. In all, 29 putative prognostic baseline variables were evaluated. Multivariate multilevel longitudinal regression analyses were conducted using neck pain, neck disability, and perceived recovery as outcomes.

Results. In total, 529 patients fulfilled the inclusion criteria. The response rate at 12-months was 92%. In the multivariate analyses, 14 (48%) of the prognostic variables examined were retained in at least one of the models. Shorter duration of neck pain at the first visit was the only variable retained in all 3 final regression models. The following were predictive of a favorable outcome for any 2 of the 3 outcome measures examined: intermittent neck pain, those not on sick-leave or receiving workers compensation at baseline, a higher level of education, less tiredness, higher expectations that the treatment would be beneficial, lack of morning pain, and worse perceived general health.

Conclusion. On the basis of the patient's history, the clinician can identify a number of determinants, which are predictive of a favorable outcome. Shorter duration of neck pain at the first visit was the only variable consistently found to be predictive of a favorable outcome for all 3 outcome measures examined.

Key words: predictors, prognostic factors, prognosis, neck pain, chiropractic, spinal manipulation, cervical spine, outcome. **Spine 2008;33:1451–1458**

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Neck pain is a common complaint in Western societies,[1] and a common motivation to seek chiropractic care.[2–4] Few studies have examined the relationship between prognostic factors and recovery, particularly for subjects with neck pain.[5] To improve outcomes with care, it is important for practitioners to be able to identify at the first encounter, before care has even commenced, who is likely to recover with the proposed therapy. Identification of predictors can, therefore, facilitate the selection of patients most likely to benefit from a particular intervention, and allow the practitioner to modify his/her care or direct patients to other disciplines.

A systematic review on neck pain found higher neck pain intensity, and previous episodes with neck pain to be predictive of a poor prognosis.[5] A more recent study also identified higher neck pain intensity, as well as self-perceived poor well-being, lower expectations of the treatment, and a current episode longer than 3 months to be predictive of a poor outcome.[6] In addition to previous episodes and longer duration with neck pain, another study identified older age (≥40 years), concomitant low back pain, previous trauma to the neck, and unchanging neck pain in the 2 weeks before baseline to be predictive of a poor prognosis.[7] To our knowledge, only one study has examined the predictive relationship of psychosocial factors and neck pain in a chiropractic setting.[8] The authors found coping strategies and high levels of social support to be associated with reduced pain or disability.

Although it is quite clear that certain factors can be identified which can predict outcome, it is less clear why some factors are predictive and others not. The biopsychosocial model[9] emphasizes the role of psychological and social factors in the development or persistence of neck or low back pain, but does not explain sufficiently why certain biomechanical elements are related to outcome. This should be considered in light of the fact that the biomedical model, based on pain as a signal of tissue damage, has been generally rejected. Nevertheless, it is

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most notably the history and physical examination that influences the decision of the clinician to treat or refer for further evaluation. To that end, this study was designed to examine which clinical and sociodemographic prognostic factors can predict a favorable outcome for subjects with neck pain undergoing chiropractic care.

Methods

Study Design and Source Population

A prospective, multicenter, practice-based cohort study was conducted for patients with nonspecific neck pain. Subjects were recruited at the first visit for neck pain by chiropractors in their private clinics throughout the Netherlands, and were followed-up at the second and fourth visit, and at 3 and 12 months. Each participating chiropractor was asked to recruit 10 consecutive new patients. The type of treatment delivered, and the number of treatments given, was left to the discretion of the chiropractor. The study was approved by the Institutional Review Board of the VU University Medical Centre, Amsterdam, the Netherlands.

Recruitment of Chiropractors and Patients

Chiropractors. All 189 chiropractors, who were members in good standing of the Netherlands Chiropractors Association, were invited to participate. Chiropractors undergoing their internship were excluded. Recruitment was pursued by means of a flyer mailed to all association members, by personal invitation, and through a presentation at a national chiropractic meeting.

Patients. Between September 1, 2004, and April 15, 2005, all new patients between the ages of 18 and 65 years with neck pain of any duration, who had not undergone chiropractic care or manual therapy in the prior 3 months and had no contraindication for cervical manipulation, were eligible for inclusion. Patients were also required to have a basic understanding of the Dutch language. Patients with specific pathology, such as a tumor or infection of the cervical spine, as well as subjects with any other condition thought to be a contraindication for cervical spinal manipulation, were excluded from participation. This was left to the discretion of the chiropractor. "Neck pain" was defined as those with neck and neck-related pain, including cervicothoracic and/or periscapular pain.

Data Collection

Procedure. Sources of data were self-administered questionnaires collected at baseline, before treatment at the second and fourth visit, and at 3 and 12 months. Envelopes were provided to the patients in which to place their completed questionnaires to facilitate an unbiased response. Long-term follow-up was conducted via the mail. If the participant failed to respond to a written reminder at 12 months, a shortened structured telephone interview was conducted. Before the start of data collection, a number of training sessions were conducted with the participating chiropractors and/or their assistants throughout the country to present the data collection procedure and limit problems associated with patient recruitment.

Putative Predictor Variables

Patient Baseline. In total, 29 patient-related, putative prognostic variables were examined (Table 1). Kinesiophobia was assessed by the Tampa Scale for Kinesiophobia (17–68 point scale),[10] whereas self-reported general health,[11,12] expected treatment effectiveness and fear of or apprehension concerning the treatment were assessed by 11-point numerical rating scales.[13–15]

Table 1. Sociodemographic and Clinical Baseline Characteristics for the Patients (N = 529)

Variables	[Mean, SD]	%
Age (yr)	41.2 (11.5)	
Kinesiophobia (17–68)	34.1 (6.2)	
General health (0–10)	6.8 (1.7)	
Expected treatment effectiveness (0–10)	7.0 (2.0)	
Fear of, or apprehension concerning the treatment (0–10)	0 (0–2) [median, IQR]	
Gender, female		69
Working status		
Full-time or Part-time(>32 hr per week)		77
Not working (incl. unemployed, housewives, retired)		15
Sick-leave or receiving workers compensation		7
Highest level of education achieved		
Primary or secondary school		36
Technical school		55
University or postgraduate education		9
Bruxism (% yes)		24
Concomitant symptoms (% yes)*		
Tiredness or fatigue		77
Headache		75
Dizziness or light-headedness		60
Nausea		35
Depression or fear		29
Confusion or disorientation		27
Ringing in the ears		23
Duration of the current neck pain		
<4 wk		8
4–12 wk		17
>12 wk		75
No. of days with neck pain in the preceding year		
<30 days		18
30–60 days		22
>60 days		60
Medication usage		
None		66
Over-the-counter pain medication		6
Prescription pain medication		6
Other prescription (nonpain) medication		22
Morning pain related to the neck pain (% yes)		70
Night pain related to the neck pain (% yes)		37
Paresthesias and/or "dead" feeling in an upper extremity (% yes)		39
Pattern of neck pain in the preceding year		
Intermittent		75
Constant		25
Prior episode with neck pain (% yes)		72
Radiating pain to an upper extremity (% yes)		52
Self-assessed status in relation to the neck pain		
Getting better		4
Staying the same		25
Varies from day-to-day		51
Getting worse		20
Who have you seen for this complaint in the prior 6 mo? (% yes)*		
General practitioner		67
Chiropractor or manual therapist		37
Medical specialist		19

*Multiple responses possible.

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Outcome Variables

The clinical outcome measures examined were neck pain in the 24 hours preceding the visit (11-point numerical rating scales),[13] neck disability (Neck Disability Index),[16,17] and perceived recovery[18–20] (6-point Likert scale: "completely improved," "much better," "somewhat better," "unchanged," "somewhat worse," "much worse"). Neck pain and disability were analyzed as continuous variables, and perceived recovery as a dichotomous variable. Those subjects who were either "completely improved" or "much better" were defined as "recovered." Neck pain and perceived recovery were measured at every follow-up period, and neck disability was measured at every follow-up except the second visit.

Analysis of the Data

Means and standard deviations (SD) were calculated for continuous baseline variables, and frequency distributions were calculated for categorical variables. For the disability and kinesiophobia questionnaires, 13% and 14% of the cohort had one or more missing values, respectively; however, only 12% of the cohort had just 1 or 2 missing values for either questionnaire. Response-function imputation, which is based on item response theory,[21] was used for missing data.[22]

Statistical Analysis and Techniques Used for the Models. Multivariate multilevel longitudinal (linear and logistic) regression analyses were used to develop prognostic models with 3 levels: time (level 1), patient (level 2), and chiropractor (level 3). For all models, time was treated as a categorical variable. Main effects of the covariates should be interpreted for the entire study period, whereas interactions with time should be interpreted as predictors of change (or the potential effect of the therapy). For the continuous outcomes, neck pain and neck disability, an unstructured within-subjects covariance matrix was used, whereas for the dichotomous outcome variable "perceived recovery," a compound symmetric within-subjects covariance matrix was used.[23] A random intercept was used at the chiropractor level.

A forward selection strategy for modeling was used.[24] First, univariate multilevel longitudinal regression analyses were performed between each potential prognostic variable and each outcome variable. In the case of a high correlation (Pearson r >0.4) between any 2 predictor variables, the predictor that had the strongest univariate association with the outcome variable was used in subsequent modeling. This was the case for only 2 variables, namely, radiating pain *versus* paresthesias, and duration of the current neck pain *versus* number of days with neck pain in the preceding year. The Wald χ^2 test was used to determine statistical significance ($P < 0.05$). These variables were subsequently added stepwise in their respective models according to the Wald test (from lowest to highest significance) until all variables remained significant at $P < 0.05$ level. After this initial model was established, we examined interaction between each of the predictor variables and time. Only significant interactions with time are reported. Each model represents then the best combination of predictor variables for each of the 3 outcome measures, and not an *a priori* selection of certain predictor variables that we thought would be associated with each outcome variable. Regression coefficients for all continuous independent variables were semistandardized, which is a form of internal standardization.[25] Confidence intervals (95%) and level of significance were calculated in the final models. Explained variance (R^2) was calculated for the model "perceived recovery."[26] According to a recent study,[27] the method used seems to be the best at estimating variance in logistic regression analyses. No R^2 was calculated for the other 2 outcomes because an unstructured covariate matrix was used. All analyses were conducted in MLwiN, version 2.02.

Results

Study Population

In total, 79 chiropractors (42% of the available population) participated in the study. Characteristics of the participating chiropractors and the types of treatments delivered are reported in detail elsewhere.[28] In almost all subjects (97%), a manipulative technique was used at any of the first 3 visits.

During the 7-month recruitment period, 579 patients were recruited, of which 529 fulfilled the inclusion criteria. Ninety-six percent and 87% of the study population returned for a second and fourth visit, respectively, whereas 90% and 92% responded to the long-term follow-up questionnaires at 3 and 12 months, respectively. Twelve percent of the 92% that responded at 12 months were evaluated using a shortened telephone assessment instead of completing the written questionnaire. Potential response bias was assessed to compare responders to nonresponders (detailed information available from the principal author). An analysis of the 3 and 12 months data showed no obvious differences between these 2 groups. A total of 4891 treatment consultations were registered during the 12-month period, and chiropractors delivered 9.3 ± 5.3 [(mean ± SD), (range, 0–38)] treatments per patient. Almost all patients (90%) returned for a second visit within 8 days of the first visit, whereas 90% returned for a fourth visit within 6 weeks of the first visit.

Sociodemographic and clinical baseline characteristics for the patients are presented in Table 1. The recruited subjects were predominantly female, middle-aged, had a high school or technical school education, and were employed. The majority of patients had a chronic complaint, which was intermittent in nature, and had at least one prior episode. The subjects had a moderate amount of pain [4.8/10 (2.4) mean, SD], little fear or apprehension concerning the treatment, expected the treatment to be effective, were generally healthy, and most (87%) had mild to moderate disability [12.8/50 (6.5) mean, SD]. Only 7% had a high level of kinesiophobia.[29] Furthermore, at baseline, many complained of headache, tiredness, or dizziness, whereas a relatively small number complained of nausea, depression, confusion, or ringing in the ears.

Outcome

The percentage of subjects with neck pain, neck disability, and those recovered at every follow-up period is reported in detail elsewhere.[28] In short, patients recovered quickly (50% reported to be recovered at the fourth visit), and continued to improve up to 3 months (67% of the cohort). There was no mean change at 12 months.

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Neck pain and neck disability demonstrated a similar pattern of improvement.

Prediction Models

Univariate Analyses. Results of the univariate multilevel longitudinal analyses are presented in Table 2. All prognostic variables, except age, were predictive of at least one of the outcomes. Working status, intermittent neck pain, number of days with neck pain, paresthesias in an upper extremity, radiating pain, a prior episode with neck pain, and having visited a general practitioner or specialist in the prior 6 months were the only variables that were significantly associated with all outcomes. In general, tiredness, general health, night pain, morning pain, intermittent neck pain, and number of days with neck pain demonstrated the highest levels of significance for neck pain and disability.

Multivariate Analyses

Neck Pain. Lower level of neck pain throughout the 12-month study period was predicted by a higher level of education, intermittent neck pain, less tiredness, and fewer days with neck pain in the preceding year (Table 3). In the following cases, there was interaction with time. Those patients with either morning pain, a higher

Table 2. χ^2 Values From the Wald Tests for the Univariate Multilevel Longitudinal Regression Analyses for All Variables Examined

	Outcome Variables		
Independent Variables	Neck Pain	Neck Disability	Perceived Recovery
Sociodemographic variables			
Age (years)			
Gender, female		17.5	
Working status: sick-leave or workers compensation (*vs.* all other categories)	15.0	68.4	13.5
Highest level of education achieved: technical or university (*vs.* primary or secondary)	14.4	12.3	
Clinical baseline variables			
Bruxism	5.5		
Concomitant symptoms:			
Tiredness or fatigue	81.7	173	
Headache	31.8	76.3	
Dizziness or light-headedness	25.7	82.6	
Nausea	6.7	25.0	
Depression or fear	16.0	59.3	
Confusion or disorientation	40.2	117	
Ringing in the ears	10.1	38.8	
Duration of the current neck pain			27.7 (2df)
No. of days with neck pain in preceding year	84.2 (2df)	57.5 (2df)	29.0 (2df)
Expected treatment effectiveness	5.9		15.7
Fear of, apprehension for the treatment	8.1	15.7	
General Health	82.8	180	
Kinesiophobia	23.4	85.9	
Medication usage	12.7 (3df)	37.1 (3df)	
Morning pain related to the neck pain	61.5	36.0	
Night pain related to the neck pain	36.9	57.2	
Paresthesias in an upper extremity	12.3	22.8	4.5
Intermittent neck pain in the preceding year	50.9	37.1	19.8
Prior episode with neck pain	9.9	8.9	5.0
Radiating pain in an upper extremity	17.6	37.9	4.2
Self-assessed status in relation to the neck pain	26.5 (3df)	21.5 (3df)	
Who have you seen for this complaint in the prior 6 mo?			
General practitioner	11.4	15.5	6.0
Specialist	15.7	31.1	8.9
Chiropractor or manual therapist		7.4	

Missing means $P > 0.05$; degrees of freedom (*df*) are presented in parentheses only when $df > 1$; cut-off points for the Wald test 3.84 (1df), 5.99 (2df), 7.81 (3df). The same categories were used as was listed in Table 1, except for working status and level of education, which were dichotomized.

Table 3. Predictor Variables That Remained in the Final Multivariate Multilevel Longitudinal Regression Model For Neck Pain (n = 424)

Independent Variables Retained in the Model	Regression Coefficient (95%CI)	*P*
Time		
at 2nd visit	−0.08 (−0.49, 0.34)	
at 4th visit	−0.53 (−1.03, −0.03)	
at 3 mo	−1.19 (−1.73, −0.65)	
at 12 mo	−1.72 (−2.29, −1.15)	
Sociodemographic variables		
Highest level of education: technical or university (vs. primary or secondary)	−0.58 (−0.85, −0.30)	<0.001
Clinical baseline variables		
No. of days with neck pain in the preceding year (<30 days)		<0.001
vs. 30–60 days	0.66 (0.25, 1.07)	
vs. >60 days	1.18 (0.82, 1.54)	
Intermittent neck pain in the preceding year (*vs.* constant)	−0.54 (−0.86, −0.22)	<0.001
Tiredness (0–10)*	0.39 (0.25, 0.53)	<0.001
Clinical baseline variables demonstrating interaction with time		
Expected treatment effectiveness (0–10)†	0.44 (0.25, 0.62)	
Expected treatment effectiveness x Time		0.005
2nd visit	−0.27 (−0.49, −0.05)	
4th visit	−0.27 (−0.54, −0.01)	
3 mo	−0.54 (−0.83, −0.26)	
12 mo	−0.32 (−0.62, −0.01)	
General Health (0–10)‡	−0.50 (−0.70, −0.30)	
General Health x Time		0.023
2nd visit	0.13 (−0.10, 0.35)	
4th visit	0.41 (0.14, 0.67)	
3 mo	0.23 (−0.06, 0.52)	
12 mo	0.37 (0.06, 0.68)	
Morning pain (*vs.* no morning pain)	1.26 (0.84, 1.68)	
Morning pain x Time		0.002
2nd visit	−0.51 (−1.00, −0.02)	
4th visit	−1.06 (−1.64, −0.47)	
3 mo	−1.07 (−1.71, −0.44)	
12 mo	−0.46 (−1.13, 0.22)	

Regression coefficients for continuous variables were semi-standardized.
*Ranging from no tiredness to worst possible tiredness.
†Ranging from no expected effectiveness to extremely effective.
‡Ranging from worst possible health to best possible health.

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level of expected treatment effectiveness, or worse general health had better outcomes.

Neck Disability. Lower level of neck disability throughout the study period was predicted by those not on sick-leave or workers compensation, a higher level of education, less fear or apprehension concerning the treatment, less headache, less kinesiophobia, no radiating pain, less tiredness, fewer days with neck pain, and no morning pain (Table 4). Interaction with time was found in the following 2 variables. Those patients with either night pain or worse general health had better outcomes.

Table 4. Predictor Variables That Remained in the Final Multivariate Multilevel Longitudinal Regression Model for Neck Disability (n = 405)

Independent Variables Retained in the Model	Regression Coefficient; 95%CI	*P*
Time		
At 4th visit	−2.59 (−3.27, −1.92)	
At 3 mo	−4.50 (−5.27, −3.72)	
At 12 mo	−4.10 (−4.91, −3.30)	
Sociodemographic variables		
Highest level of education: technical or university (*vs.* primary or secondary)	−1.45 (−2.28, −0.63)	<0.001
Working status: sick-leave or workers compensation (*vs.* all other categories)	4.49 (2.95, 6.03)	<0.001
Clinical baseline variables		
Fear of, or apprehension concerning treatment (0–10)*	0.42 (0.03, 0.80)	0.036
Headache (0–10)†	0.98 (0.53, 1.43)	<0.001
Kinesiophobia (17–68)‡	1.07 (0.68, 1.46)	<0.001
Morning pain (*vs.* no morning pain)	1.05 (0.13, 1.97)	0.026
No. of days with neck pain in the preceding year (<30 days)		<0.001
30–60 days	0.48 (−0.75, 1.71)	
>60 days	2.10 (1.04, 3.17)	
Radiating pain (*vs.* no pain)	1.17 (0.35, 2.00)	0.005
Tiredness (0–10)§	1.35 (0.87, 1.84)	<0.001
Clinical baseline variables demonstrating interaction with time		
General health (0–10)	−1.64 (−2.15, −1.14)	
General health x Time		<0.001
4th visit	1.18 (0.64, 1.72)	
3 mo	1.18 (0.55, 1.82)	
12 mo	0.97 (0.29, 1.65)	
Night pain (*vs.* no night pain)	1.66 (0.69, 2.63)	
Night pain x Time		<0.001
4th visit	−1.65 (−0.56, −2.75)	
3 mo	−0.17 (−1.45, 1.10)	
12 mo	−1.60 (−2.94, −0.26)	

Regression coefficients for continuous variables were semi-standardized.
*Ranging from not afraid or apprehensive concerning the treatment to very afraid or apprehensive concerning the treatment.
†Ranging from no headache to intolerable headache.
‡Ranging from no fear of movement to a great deal of fear of movement.
§Ranging from no tiredness to worst possible tiredness.

Perceived Recovery. Recovery throughout the study period was predicted by those not on sick-leave or workers compensation, intermittent neck pain, no previous episode with neck pain, and those with higher expectations of treatment effectiveness (Table 5). Subjects with <30 days of neck pain were more likely to recover compared to subjects with >60 days neck pain. Recovery favored the intermediate group (30–60 days of neck pain) at the second visit only.

Explained Variance. The explained variance for the model perceived recovery was reasonable (47%). In a separate model, 43% of the variance could be explained using the 3 most significant variables (intermittent neck pain, expected effectiveness, and duration), whereas 39% of the variance could be explained by just one variable, duration with neck pain. Explained variance was not analyzed for the other 2 outcome variables because of the complex variance-covariance matrix structure.

Table 5. Predictor Variables That Remained in the Final Multivariate Multilevel Longitudinal Regression Model for Perceived Recovery (n = 479)

Independent Variables Retained in the Model	Odds Ratio; 95%CI	*P*
Time		
At 4th visit	2.68 (1.21, 5.89)	
At 3 mo	14.63 (6.04, 35.41)	
At 12 mo	8.87 (3.89, 20.25)	
Sociodemographic variables		
Working status: sick-leave or workers compensation (*vs.* all other categories)	0.40 (0.18, 0.89)	0.025
Clinical baseline variables		
Expected treatment effectiveness (0–10)*	1.52 (1.24, 1.85)	<0.001
Intermittent neck pain in the preceding year (*vs.* constant)	2.13 (1.32, 3.43)	0.002
Previous episode with neck pain (*vs.* no previous episode)	0.57 (0.37, 0.88)	0.011
Clinical baseline variables demonstrating interaction with time		
No. of days with neck pain in the preceding year (*vs.* <30 days)		<0.001
30–60 days		0.087
at 2nd visit	0.32 (0.13, 0.79)	
at 4th visit	1.35 (0.54, 3.37)	
at 3 mo	0.93 (0.33, 2.58)	
at 12 mo	1.17 (0.45, 3.07)	
>60 days		<0.001
at 2nd visit	0.22 (0.10, 0.49)	
at 4th visit	0.67 (0.31, 1.46)	
at 3 mo	0.28 (0.12, 0.66)	
at 12 mo	0.51 (0.23, 1.13)	
McKelvey-Zavoina R^2 = 47%		

Regression coefficients for continuous variables were semi-standardized.
*Ranging from no expected effectiveness to extremely effective.

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Summary of Findings

In short, only one independent variable, number of days with neck pain in the preceding year, was predictive of all 3 outcome measures in the final multivariate models. Working status, level of education, intermittent neck pain, tiredness, expected effectiveness, general health, and morning pain were retained in the final model for any 2 of the 3 outcome measures. Fear of, or apprehension concerning the treatment, headache, kinesiophobia, radiating pain, previous episode, and night pain were predictive of just one of the outcomes.

Discussion

In this study, a number of determinants were identified, which were predictive of a favorable outcome. It is interesting that despite a relatively large number of predictor variables were examined, only one variable, number of days with neck pain, was retained in all 3 models. This underlines earlier observations that duration of pain is a consistent predictor of outcome for numerous musculoskeletal complaints.[30–37] Other variables found to be associated with a poor prognosis include longer duration of neck symptoms at baseline,[6,7,30] higher severity of neck pain at baseline,[5] a previous episode with neck pain,[1,5–7,30] night pain,[7] radiating pain,[7] higher degree of headache,[7] lower expectations of the treatment,[6] and worse level of well-being.[6] One study found not working to be predictive of persistent neck pain 1 year later.[38] It must be noted that most studies in this area have examined predictors of a poor prognosis, whereas we examined predictors of a favorable outcome. This should not be taken to imply than that the absence of any of these above-mentioned variables necessarily result in a favorable outcome.

Caution is urged when interpreting the findings of this study because no *a priori* hypothesis was tested. Rather we conducted a "naïve" analysis in which we examined stepwise a large number of predictor variables against 3 different outcome measures. Incidental findings are therefore possible, particularly for those predictors retained in only one model.

A remark, however, must be made about the interaction terms because, for example, it seems counterintuitive that patients with morning pain, or worse general health had relatively better outcomes with respect to the outcome measure neck pain (Table 3). For example, in the case of general health, although patients with worse general health had more pain at baseline, they profited more from the treatment (or from the passing of time). This is to be seen on the direction of the interaction terms in the table. This is a similar case for the patients with morning pain.

Which Predictors for Which Outcome Measure?

Although it has become standard practice for studies to include several outcome measures, the reality is, interpreting the results from multiple outcome measures can be confusing. Neck pain, neck disability, and perceived recovery all reflect different aspects of improvement. The question is, which outcome is most useful to the clinician, and more importantly, what matters most to the patient? It has been suggested that pain intensity is more related to changes at a tissue or organ level, whereas disability is more influenced by personal or social factors.[6] Both pain and disability are described in the model by Waddell,[9] and in other models of disablement.[39,40] Still, from the perspective of the patient, recovery is desirable. This, however, might be an unrealistic goal, especially for subjects with chronic, recurrent neck, or low back pain. The outcome measure chosen should be dictated by the goals of the clinician and patient, and the setting in which therapy is conducted, so there may not be a universal gold standard.

Explained Variance

Despite the numerous predictors examined, the model for perceived recovery could explain only approximately half of the variability. Heterogeneity among the study population and potential misclassification of the outcome variable might explain this observation. The inclusion of additional predictors, such as psychosocial or work-related factors might have improved predictive ability; however, the chiropractor does not typically systematically evaluate these during the initial health care encounter. Rather he/she limits the evaluation to predominantly physical and historical findings, which underlines the goal of this study, namely, to evaluate the predictive ability of the variables assessed during the first clinical encounter.

Principal Limitations and Strengths

Principal limitations include potential misclassification of perceived recovery, lack of hypothesis testing, and lack of a control group. First, patients were asked about recovery using a 6-point scale, but in the analyses we subsequently defined recovery as recovered or not recovered. Second, we did not explicitly test a hypothesis, but rather explored the identification of predictors, meaning therefore, that incidental associations are possible. Third, although we recognize that the lack of a control group limits the interpretation because recovery or improvement could be ascribed to natural history, there is sufficient documentation in the form of recent systematic reviews which suggests that chiropractic care/spinal manipulative therapy for subjects with neck pain is more effective than placebo or natural history.[41–44] The issue is, however, not whether the mechanism of improvement is due to chiropractic care or natural history, but rather that the chiropractor can identify certain variables predictive of recovery or improvement, and based on these results can properly inform his/her patients.

A major strength of this study is our analysis of the data. We analyzed the data by modeling the trajectories of subjects in a longitudinal design, rather than as is typically done with longitudinal data sets, which is to

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compare a particular follow-up measurement to baseline. Those types of analyses result in different sets of regression coefficients for each predictor variable at each different time interval. This undoubtedly results in an overabundance of information for the clinician, and begs the question, which regression coefficient should be considered? The distinguishing feature of longitudinal studies is that study participants are measured repeatedly throughout the duration of the study. This allows one to assess within-individual changes over time.[23] Perhaps, the real advantage with this technique is to determine how within-individual changes in the outcome variable are related to selected covariates. In other words, it allows one to look at the response to an intervention over time. Interestingly, no previous study on predictors of neck pain has analyzed the data in this manner, despite the fact that these kinds of data sets are well suited to this type of analytical technique. Other strengths include the use of multilevel modeling (which corrects for clustering of patients within individual chiropractors, and thus the interdependency of individual data points), a large prospective sample, and a high follow-up rate. In addition, treatment provided was at the discretion of the chiropractors, making it possible to examine a large number of treatments delivered by a diverse group of chiropractors. Therefore, these results can be better extrapolated to clinical practice rather than to studies with a prescribed treatment protocol.

Conclusion

On the basis of the patient's history, the clinician can identify a number of determinants which are predictive of different types of outcomes. Shorter duration of neck pain was the only variable consistently found to be a predictor of perceived recovery, less neck disability, and diminished neck pain.

Key Points

- A prospective, multicenter, cohort study was conducted to identify prognostic variables that predict a favorable outcome in subjects receiving chiropractic care for neck pain.
- In total, 29 putative prognostic variables were examined in 529 patients, who were followed-up within the first 3 visits, and at 3 and 12 months.
- Multivariate multilevel longitudinal regression analyses were conducted using 3 outcome variables: neck pain, neck disability, and perceived recovery.
- The following were predictive of a favorable outcome: intermittent neck pain, those not on sick-leave or receiving workers compensation at baseline, a higher level of education, less tiredness, higher expectations that the treatment would be beneficial, lack of morning pain, and worse perceived general health.
- Only one variable, shorter duration of neck pain, was consistently found to be a predictor of a favorable outcome for all 3 outcome measures examined.

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