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# Centralization Phenomenon as a Prognostic Factor for Chronic Low Back Pain and Disability

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**Study Design.** Two hundred twenty-three consecutive adults with acute low back pain with or without referred spinal symptoms were treated conservatively and followed prospectively for 1 year.

**Objectives.** To investigate the predictive value of centralization phenomenon (CP) with psychosocial variables previously identified as important risk factors for patients with acute onset of nonserious or nonspecific low back pain who subsequently develop chronic pain or disability.

**Summary of Background Data.** Psychosocial factors have been shown to be predictors of chronic disability, but measures from physical examination rarely predict chronic behavior. The authors of the present study investigated whether dynamic assessment of changes in clinical measures during treatment could be used to classify patients and predict occurrence of chronic pain or disability.

**Methods.** Patients with acute symptoms and no history of surgery were treated by five physical therapists trained in McKenzie evaluation/treatment methods. Seventy-three percent were receiving workers' compensation benefits. At initial evaluation and discharge, 23 independent variables were assessed representing psychosocial, clinical, and demographic factors. Pain location changes to repeated trunk movements were assessed at every visit. Patients were placed in two groups: 1) those with pain that did not centralize and 2) those who completely centralized or demonstrated partial reduction of pain location with time. Treatment was individualized and based on McKenzie methods. Patients were contacted at 12 months after discharge, and dependent variables of pain intensity, return to work status, sick leave at work, activity interference at home, and continued use of health care were assessed.

**Results.** Nine independent variables influenced pain symptoms or disability. Pain pattern classification (noncentralization) and leg pain at intake were the strongest predictive variables of chronicity.

**Conclusion.** Dynamic assessment of change in anatomic pain location during treatment and leg pain at intake were predictors of developing chronic pain and disability. [Key Words: acute spinal pain, anatomic pain location, centralization, pain patterns, predictors of chronic disability] **Spine 2001;26:758–765**

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Finding predictors for low back pain chronicity and disability early after an acute attack of nonserious or nonspecific back pain is an important primary care research priority.[3] Accurate identification of patients who subsequently develop chronic back pain and disability would allow expensive medical evaluation and intervention to be directed to appropriate patients and avoid unnecessary treatment for patients likely to recover spontaneously or who will benefit from less costly interventions.

In spite of extensive research efforts to identify this "at-risk" patient population, the relative importance of predictive variables for developing chronic low back pain and disability remains unclear.[4–8,12,15,22,23,25,26,33,34,37,38] Prevailing conclusions to date have confirmed that psychosocial factors play dominant predictive roles, and measures from physical examination have limited power in predicting chronic disability. Type of treatment has not been predictive of future pain behavior. The frequently cited reason for the lack of predictive power for conventional physical measures and treatments for patients with nonspecific low back pain syndromes is that nonspecific low back pain is ill defined and rarely has a confirmed diagnosis.[41] This makes grouping patients with similar problems difficult, contributes to the difficulty treating and managing patients, and reduces the power of outcome assessment.[10,41]

Prior studies developing predictive models for the development of chronic pain and disability after an acute episode of nonspecific low back pain have emphasized baseline measurements of predictive variables at only one point in time, which is operationally defined here as a static assessment.[4,6,12,22,23,26,34,37] Waddell[49] hypothesized that observing patient progress with time, which is operationally defined here as a dynamic assessment, may be more predictive of long-term outcomes than a singular or static assessment, and he recommended making these dynamic assessments early after the onset of acute pain. Researchers have found that the first few weeks after the acute onset of pain is a critical period for evaluating patient progress.[5,26,38] These findings are supported by Werneke et al,[52] who continuously evaluated patient responses to examination and treatment by documenting dynamic changes in pain location at each visit. If a favorable change in pain location occurred, better outcomes were obtained. If a favorable change in pain location did not occur by the seventh treatment visit, poor short-term outcomes in pain and disability were observed. Dynamic assessment of change in symptoms in response to intervention, if performed soon after acute onset of back pain, may be important for identifying

patients at risk for delayed recovery and, therefore, merit further analysis.[52,53]

One pain pattern response amenable to dynamic assessment is the centralization phenomenon (CP).[36] The CP is clinically induced by specific test movements.[21,52] The CP represents a favorable change in the location of pain from a distal or peripheral location to a more proximal or central spinal position. An operational definition for centralization has been described previously, and the process used to confirm centralization has been shown to be reliable.[52] Interest in CP has increased because of its reported predictive value in identifying patients who will respond satisfactorily to conservative intervention.[16,31] Studies have shown that patients who are classified as centralizers return to work sooner and have greater improvement in pain and function compared with patients classified as noncentralizers.[16,31,35,43,52] Although some profess the prognostic value of CP, the assessment of the prognostic power of CP has been limited by short-term outcome assessment, samples that included patients with acute and chronic symptoms, or failure to simultaneously consider psychosocial risk factors in the analysis of outcomes.[16,31,43,52]

Therefore, the purpose of the present study was to investigate the predictive value of CP in a multivariate model with psychosocial variables identified in the literature as important risk factors for patients with an acute onset of nonspecific low back pain who subsequently develop chronic pain and disability. Five dependent variables associated with chronic pain and disability were assessed prospectively 12 months after discharge from physical therapy. It previously was observed that the real predictive value of the CP appears to be documenting its absence, *i.e.*, peripheralization or no proximal change in pain location during treatment.[52] Therefore, it was hypothesized that a noncentralization pain pattern determined early during treatment would be an important independent variable predicting future chronic pain and disability. Traditional physical impairment measures were excluded in this study because of previously documented poor predictive power in identifying chronic back pain troubles in patients with an acute onset of nonspecific low back pain syndromes.[4,8,12,23,26,34,37]

## ■ Methods

**Design.** The design was prospective with follow-up evaluation 1 year after discharge from physical therapy services. This is a secondary analysis of a previously described cohort of patients with acute onset of nonspecific neck or low back syndromes.[52] Sixty-six patients with cervical syndromes were excluded, leaving 223 patients with low back pain syndromes as the final sample.

**Procedure.** At initial physical therapy consultation, patients completed a battery of questionnaires gathering medical information including demographic, pain, historical, job, and psychosocial factors. After completing the intake questionnaires, all patients received a mechanical evaluation following McKenzie's assessment methods[36] by one of five physical therapists during the initial physical therapy evaluation. Patients were reassessed using similar techniques at each treatment visit. Distribution of patients treated by each physical therapist was skewed because of physician referral pattern, clinic location, and length of therapist employment. The majority of patients were evaluated by three senior physical therapists. The percentage of patients per therapists was 65%, 18%, 10%, 5%, and 2%.

The physical therapy examination emphasized repeated test movements.[36] Precise changes in pain location in response to trunk movements were documented following previously described techniques.[52] No other physical measurements were analyzed. Additional treatment and testing procedures have been previously described.[52]

**Independent Prognostic Factors.** Potential prognostic data (independent variables) were collected during the initial physical therapy visit. Three rehabilitation program factors determined at discharge from rehabilitation also were included as potential prognostic variables (Table 1).

**Outcome Measures.** It has been recommended that outcomes after treatment for an episode of acute spinal pain must be comprehensive and as long-term as possible.[14,47] There is growing consensus that not only work status but also measures of pain and disability (activity limitation) must be adequately assessed with time to determine the impact of any intervention on the natural course of low back pain on the individual.[13,14,46,47] Therefore, the following dependent variables were assessed 1 year after discharge: 1) maximal pain intensity, 2) work status, 3) sick leave or downtime at work, 4) activity interference or downtime at home, and 5) continued health care utilization.

Maximal pain intensity during the past week assessed 12 months after discharge from therapy was recorded using a scale of 0–10 with 10 being the highest pain experienced.[30] Pain intensity was represented as a categorical variable: 0–5 was considered low, and 6 or more was considered high.[46]

Return to work status was considered good if the patient was working full time, full duty. A less than optimal outcome was defined as the patient working less than full time, full duty, and included: 1) part time, light duty, 2) full time, light duty, 3) part time, full duty, or 4) not working.[24]

Sick leave or downtime at work was described as the number of days lost from work in the previous 6 months secondary to the same back pain problem for which the patient had been treated. A good outcome was operationally defined as 0–7 days lost from work since discharge. A poor outcome was described as more than 7 days lost from work.[46]

Activity interference or downtime at home in the previous 6 months was described as the number of days that back pain caused the patient to reduce the activities usually accomplished at home for more than half of the day. A good outcome was operationally defined as 0–7 days lost because of pain since discharge. A poor outcome was described as more than 7 days lost.[46]

Continued use of health care services was quantified by the number of consultations/visits to another physician, medical specialist, chiropractor, or other health care provider for the back problem for which the patient had been treated during the last 12 months. A good outcome was operationally defined as no consultations or visits. One or more additional consultations or visits were defined as a poor outcome.[17]

Patients were contacted by telephone 1 year after discharge from physical therapy services. One occupational nurse expe-

**Table 1. Independent Variables (n = 223)**

| | Type | Measurement |
|---|---|---|
| Demographic and Historical Variables: | | |
| Age, yrs | Continuous | 37.8 ± 9.9 |
| Gender | Categorical (yes/no) | 52% male |
| Multiple sites of pain | Categorical (yes/no) | 18.2% yes |
| Leg pain at intake | Categorical (yes/no) | 30.7% yes |
| Pain intensity at intake | Categorical (high/low)§ | 79.6% high |
| Duration of symptoms | Continuous | 13.3 ± 9.6 days |
| Prior spinal pain | Categorical (yes/no) | 45.3% yes |
| Prior work loss | Categorical (yes/no) | 11.6% yes |
| Prior Workers' Compensation benefits | Categorical (yes/no) | 9.8% yes |
| Payer | Categorical | |
| Workers' Compensation | | 76.0% |
| Automobile or other commercial insurance | | 24.0% |
| Job Factors: | | |
| Physical Demand Characteristic[19] | Categorical | |
| Sedentary | | 14.2% |
| Light | | 14.7% |
| Medium | | 25.3% |
| Heavy | | 27.6% |
| Very Heavy | | 18.2% |
| Full duty, full-time work status at intake | Categorical (yes/no) | 10.7% yes |
| Days off work | Continuous | 4.6 ± 7.5 days |
| Work satisfaction¶ | Categorical (high/low)* | 56.4% high |
| Psychosocial Factors: | | |
| Non-organic physical signs[49] | Categorical (high/low)† | 10.2% high |
| Overt pain behaviors[32,42] | Categorical (yes/no)‡ | 11.6% yes |
| Depressive symptoms[11] | Categorical (high/low)* | 47.1% high |
| Somatization[11] | Categorical (high/low)* | 45.3% high |
| Fear–avoidance beliefs about physical activities[50] | Categorical (high/low)* | 45.3% high |
| Fear–avoidance beliefs about work activities[50] | Categorical (high/low)* | 49.3% high |
| Perceived disability at intake[18] | Categorical (high/low)‖ | 63.1% high |
| Rehabilitation Program Factors: | | |
| Satisfaction with therapy | Categorical (high/low)* | 52% high |
| Perceived disability at discharge[18] | Categorical (high/low)‖ | 16.9% high |
| Pain pattern classification[52] | Categorical | |
| Centralization and partial reduction group | | 77.3% |
| Non-centralization group | | 22.7% |

* High/Low score determined by median split.
† High score: 3 or more positive Waddell Signs.[49]
‡ High score 2 or more overt pain behaviors.[42,51]
§ High score: 6 or more on a scale of 0–10.[46]
‖ High score: 40 or more on a scale 0–100.[18,38,45]
¶ Work satisfaction scale adapted from Israel.[29]

rienced in collecting structured telephone interview data conducted outcome assessments.[9,48] The nurse was blinded from patient demographics, pain pattern classification, or response to treatment (83.9% follow-up rate).

**Data Analyses.** The relation of each of the 23 independent variables (excluding perceived disability at intake (Table 1) to each of the five dependent variables was assessed with univariate analyses (Table 2). Two-sample *t* tests were used to compare a continuous independent variable to a dichotomous dependent variable, *i.e.*, return to work with age, duration of symptoms, and days off. Chi-square tests for independence were used to compare two categorical variables, *i.e.*, down time at work with gender, multiple sites, and overreaction.

The predictive power of each independent variable found to be significantly related to a dependent variable from the univariate analyses was assessed using multiple logistic regression analyses.[27,28] Each categorical dependent variable was labeled in a binary fashion, *i.e.*, good *versus* worse. All independent variables were ordered in a similar manner, either binary (good *vs.* worse) or categorical (low to high). Logistic regression analyses were used to examine whether any independent variable was predictive of a dependent variable 12 months after discharge from therapy. Likelihood ratio $\chi^2$ statistics were calculated for each logistic model. Odds ratios were calculated for each independent variable. The classificatory power of each model was assessed by calculating the adjusted sensitivity and specificity of each multivariate model (alpha = 0.05). There were five models, one for each dependent variable. Only independent variables found to be significantly related to the dependent variable in the univariate analyses were included in each final logistic model.

## ■ Results

### *Contacted Patients* versus *Noncontacted Analyses*

One hundred eighty-seven (83.9%) patients were contacted for the 12-month follow-up interview. There were few differences between the patients contacted compared with those who were not contacted for the independent variables (Table 1). The 38 patients who were lost to follow-up evaluation were younger than the contacted patients (32.7 ± 8.2 *vs.* 38.9 ± 9.9, two-sample t =

**Table 2. Univariate Analyses of Independent Variables**

| Independent Variables | Outcome Variables at 12 Months | | | | |
|---|---|---|---|---|---|
| | Pain Intensity | RTW | Sick Leave at Work | Activity Interference At Home | Cont. Use of Health Care |
| Demographic and Historical Variables: | | | | | |
| Multiple sites of pain† | | 0.030 | | | |
| Leg pain at intake† | | 0.030 | 0.001 | | |
| Pain at intake† | | 0.030 | | 0.030 | |
| Payer† | | 0.050 | | | |
| Age* | | | | | |
| Gender† | | | | | |
| Duration of symptoms* | | | | | |
| Prior spinal pain† | | | | | |
| Prior work loss† | | | | | |
| Prior Workers' Compensation benefits† | | | | | |
| Job Factors: | | | | | |
| Physical Demand Characteristic[19]† | | | | | |
| Work status at intake† | | | | | |
| Days off work* | | | | | |
| Work Satisfaction[29]† | | | | | |
| Psychosocial Factors: | | | | | |
| Overt pain behaviors[32,42]† | | 0.030 | 0.040 | 0.040 | |
| Non-organic physical signs[49]† | 0.010 | | | | |
| Fear of work activities[50]† | | 0.040 | | | |
| Depressive symptoms[11]† | | | | | |
| Somatization[11]† | | | | | |
| Fear of physical activities[50]† | | | | | |
| Rehabilitation Program Factors: | | | | | |
| Perceived disability at discharge[18]† | 0.001 | 0.004 | 0.001 | 0.003 | 0.050 |
| Pain pattern classification[52]† | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 |
| Satisfaction with therapy† | | | | | |

RTW = return to work; Cont. = continued.
* Two-sample *t* tests for continuous variables compared to each dependent variable.
† Chi-square test for dichotomous or categorical variables; Empty cell is not significant; numbers are *P* values.

$-4.04$, $df = 60.8$, Bonferroni adjusted $P = 0.001$). A higher proportion of noncontacted patients compared with contacted patients displayed more overt pain behaviors (23.7% positive compared with 9.1%, Yates corrected $\chi^2 = 5.2$, $df = 1$, $P = 0.02$).[32]

### *Univariate Analyses*

The results of the univariate analyses are displayed in Table 2. Nine of the 23 independent variables affected the dependent variables. Overt pain behavior,[32] perceived disability at discharge,[18] and pain pattern classification[52] were the most common variables affecting the dependent variables.

### *Multivariate Analyses*

The results of the multivariate analysis are shown in Table 3. Only pain pattern classification and leg pain at intake were significant for predicting chronic pain and disability.

## ■ Discussion

This is the first prospective long-term study investigating the centralization phenomenon (CP) as a predictor of

**Table 3. Multivariate Logistic Regression Analyses for Independent Variables that Were Significant in the Univariate Analyses**

| Independent Variables | Outcome Variables at 12 Months | | | | |
|---|---|---|---|---|---|
| | Pain Intensity | RTW | Sick Leave Work | Activity Interference At Home | Cont. Use of Health Care |
| Leg pain at intake | | | S | | |
| Pain Pattern Classification[52] | S | S | | S | S |
| Logistic Regression Model Statistics | | | | | |
| Sensitivity | 0.28 | 0.24 | 0.15 | 0.30 | 0.24 |
| Specificity | 0.77 | 0.90 | 0.90 | 0.80 | 0.84 |
| Percent of patients correctly predicted | 64.7 | 82.3 | 81.4 | 69.4 | 73.4 |
| Odds ratio | 3.0 | 9.4 | 4.0 | 5.2 | 4.4 |
| 95% Confidence Interval for odds ratio | 1.4–6.4 | 3.4–26.0 | 1.5–10.5 | 2.4–11.3 | 2.0–10.1 |
| *P* value | 0.004 | <0.001 | 0.004 | <0.001 | <0.001 |

S = significant ($P < 0.05$); RTW = return to work; Cont. = continued.

chronic pain and disability in a large group of patients with an acute onset of nonserious or nonspecific low back pain syndromes. Centralization phenomenon was evaluated with an array of psychosocial factors previously identified as potential prognostic variables (Table 1). Being classified in the noncentralization group was a predictor of those who did not return to work, continued to report pain symptoms, had extended activity interference or downtime at home, and continued to use health care resources. Having leg pain at intake was a predictor of those who had high sick leave or downtime at work.

The identification of predictors for chronic pain and disability early after an acute onset of low back pain was reported to be an important primary care research priority. In fact, this priority changed dramatically between the 1995 and 1997 Agenda for Primary Care Research on Low back Pain and moved from 13th to second highest ranking.[3] Previously, physical factors have not contributed appreciably to models predicting outcomes for patients with an acute onset of low back pain. Measurements from the physical examination have been considered to be poor guides in assessing a patient's progress. During the past decade, research comparing physical and psychosocial variables consistently has reported that nonphysical factors are the most important predictors explaining chronic low back pain and disability.[4,8,12,23,26,34,49] The results of the present study do not support this conclusion.

The present study provides evidence that the dynamic assessment of anatomic pain location changes identified during mechanical examination based on McKenzie assessment methods[36] and classification of patients into different pain pattern groups (*i.e.*, centralization and partial reduction *vs.* noncentralization) were significant factors for identifying patients who failed to respond to early, active rehabilitation and who developed chronic disability.[52] The data support that the identification of those who do not centralize, *i.e.*, patients classified in the noncentralization group, is an important clinical finding predictive of future disability and health care usage.

There are two reasons that may explain these results. First, classification of patients by dynamic changes in pain location, to the authors' knowledge, has never been included as an independent physical variable in long-term biopsychosocial studies investigating the development of chronic pain/disability in patients with an acute onset of low back troubles. Although medical interest in CP has increased during the past decade because of its reported high prevalence in the clinic and its predictive value in identifying patients who will respond to treatment, CP has been relatively ignored in the literature. Based on the present findings, the impact of dynamic assessment of changes in pain location that can be used to classify patients into more homogeneous treatment groups on outcome merits further investigation.

Second, prior research investigating long-term disability predictors primarily has assessed the independent variables at only one point in time (static assessment), *i.e.*, during the initial evaluation.[4,6,12,22,23,26,34,37] In a previous study,[52] patient responses to repeated movement tests were continuously evaluated by documenting changes in pain location at each visit (dynamic assessment). If a favorable change in pain location had not occurred by the seventh treatment visit, these patients had poor short-term outcomes compared with the patients in the centralization or partial pain reduction groups.[52] It was hypothesized that the patients who were classified in the noncentralization group were at higher risk for developing chronic disability. This hypothesis was supported by the results of the present study.

The only other independent variable remaining significant at 1 year for poor outcomes was leg pain at intake. Subjects with leg pain at intake were four times more likely to have high sick leave or downtime at work compared with patients without leg pain. Referred leg pain previously has been shown to have a poor prognosis.[4,7,37] Leg pain at intake was not correlated to the other dependent variables investigated in the present study. Perhaps sick leave from work represents a different outcome construct and is influenced by factors other than the pain and disability perceived by the patient.[34,40]

The results of the five logistic regression models were similar: they all had low sensitivity, high specificity, and successfully predicted 65–82% of the proportion of patients who had good or worse outcomes. The purpose of the present study was to identify predictors for the development of chronic low back pain and disability. Although leg pain at intake and pain pattern classifications were important predictors in the multivariate models, these variables do not appear to be powerful. Take, for example, a patient classified into the noncentralization group. This patient is five times more likely to have downtime at home compared with a patient classified in the centralization or partial reduction group. Because the sensitivity was low, however, the strength of the predictor needs to be interpreted cautiously.[39,44]

### *Limitations*

The present study did not provide a comprehensive and structured psychological interview. This could be a confounding factor explaining why psychosocial risk factors did not play a more dominant role in predicting chronic pain and disability in this study. Detailed assessment instruments such as the MMPI (Minnesota Multiphasic Personality Inventory) and SCID (Structured Clinical Interview for DSM-III-R) are time consuming, expensive, and not practical for widespread clinical use when assessing patients with an acute onset of low back pain. The devices used in this study to evaluate various behavioral,[32,49] emotional,[11] and cognitive factors[18,50] have been recommended in the literature as reliable first-stage psychosocial screening tools that can be given by nonpsychologists. There are many other useful psychometric tools available in the literature. These clinical tests were chosen because they were documented in the literature and were easy to administer and interpret. Therefore, the

results of this study should be interpreted by the psychosocial measurements used.

Not all patients were contacted at the 1-year assessment point. The noncontact group was younger and demonstrated more overt pain behaviors.[32] There is no consensus on the relative importance of age as a predictive factor. For example, Abenhaim et al[1] found that older patients had a five times higher risk for chronic work absenteeism compared with younger patients; Cherkin et al[7] found younger patients at higher risk for delayed recovery. Other studies did not find age to be a significant predictive variable.[8,12] The authors do not believe that the age difference found between the respondents (38.9 ± 9.9 years) and nonrespondents (32.7 ± 8.2 years) was a confounding factor in the present study because the difference, although significant, appears small enough to be considered clinically unimportant. Capturing fewer patients with overt pain behaviors could have weakened the prognostic power of this independent variable. Although a higher proportion of nonrespondents displayed more overt pain behaviors,[32,42] there was no difference in nonorganic signs between the contact and noncontact groups.[49] Nonorganic signs and overt pain behaviors could measure different psychosocial constructs which merits further investigation.[51]

The number of patients evaluated per therapist was skewed to the three senior therapists, with one therapist seeing the majority of patients (65%). The operational definitions for centralization and pain pattern classification used in this study, however, were well defined in a previous study to minimize subjective decision-making.[52] The pain pattern classification was based solely on numerical changes in pain location scores observed during treatment visits, and intertester reliability has been shown to be excellent, which should minimize any confounding effect of clinical bias.[52] A recent independent study found substantial agreement concerning judgments of the CP between examiners regardless of the clinical experience of the examiners.[20]

The operational definition of centralization was applied to employed patients with nonspecific acute low back pain syndromes. Although all patients were employed, only 10.7% were working full time, full duty at the time of treatment. The generalizability for patients with chronic low back pain and neurologic deficits has not been established and requires further analysis.

## ■ Conclusions

Dynamic assessment of pain pattern classification was a predictive variable for the development of chronic pain and disability using multivariate models. Pain pattern classification, *i.e.*, centralization *versus* noncentralization, was determined by evaluating anatomic pain location response to dynamic mechanical assessment during a short period of intervention. Patients classified in the noncentralization category were at higher risk for delayed recovery and the development of chronic low back pain and disability.[52] This "at-risk" patient group can be identified early after an acute attack of nonserious low back pain syndromes. Patients classified in the noncentralization pain pattern should be monitored and may need to be referred early for multidisciplinary evaluation.[2] In addition, dynamically observing the patient's progress with time (pain pattern classification) was a predictor of long-term outcomes compared with other psychosocial variables statically assessed at only one point in time. These results extend support for classifying patients with acute spinal pain according to movement signs and symptoms for improved prediction of outcomes from multivariate models.

### ■ Key Points

- Dynamic assessment of change in anatomic pain location following the McKenzie protocol and leg pain at intake were predictors for the development of chronic low back pain and disability.
- Evaluating and classifying patients with acute spinal pain according to movement signs and symptoms was important for improved prediction of long-term outcomes from multivariate models.
- Patients classified in the noncentralization pain pattern category after an acute attack of nonspecific low back pain are not only at higher risk for delayed recovery, but also are at risk to develop chronic disability and greater healthcare usage.

## References


1. Abenhaim L, Rossignol M, Gobielle D, et al. The prognostic consequences in the making of the initial medical diagnosis of work-related back injuries. Spine 1995;20:791–5.
2. Accident Rehabilitation, Compensation Insurance Corporation and the National Health Committee. New Zealand acute low back pain guide. Wellington, NZ: Ministry of Health, 1997:1–13.
3. Borkan JM, Koes B, Reis S, et al. A report from the Second International Forum for Primary Care Research on Low back Pain. Re-examining priorities. Spine 1998;23:1992–6.
4. Burton AK, Tillotson KM, Main CJ, et al. Psychosocial predictors of outcome in acute and subchronic low back trouble. Spine 1995;20:722–8.
5. Carey TS, Garrett JM, Jackman AM. Beyond a good prognosis. Examination of an inception cohort of patients with chronic low back pain. Spine 2000; 25:115–20.
6. Cats-Barl WL, Frymoyer JW. Identifying patients at risk of becoming disabled because of low back pain. The Vermont Rehabilitation Engineering Center Predictive Model. Spine 1991;16:605–7.
7. Cherkin DC, Deyo RA, Street JH, et al. Predicting outcomes for back pain seen in primary care using patient's own criteria. Spine 1996;21:2900–7.
8. Coste J, Delecoeuillerie G, Cohen de Lara A, et al. Clinical course and prognostic factors in acute low back pain: An inception cohort study in primary care practice. BMJ 1994;308:577–80.
9. De Leeuw ED, Van der Zouwen J. Data quality in telephone and face to face surveys: A comparative meta-analysis. In: Telephone Survey Methodology. Edited by RM Groves, et al. New York, NY: John Wiley and Sons, 1988: 283–99.
10. Delitto A, Cibulka M, Erhard R, et al. Evidence for use of an extension-mobilization category in acute low back syndrome: A prescriptive validation pilot study. Phys Ther 1993;73:216–22.
11. Derogatis LR. Symptoms Checklist-90. Administration, Scoring, and Procedures Manual for the Revised Version. Baltimore, MD: Clinical Psychometric Research, 1977.
12. Deyo RA, Diehl AK. Psychological predictors of disability in patients with low back pain. J Rheumatol 1988;15:1557–64.
13. Deyo RA. Measuring the functional status of patients with low back pain. Arch Phys Med Rehabil 1988;69:1044–53.

14. Dionne CE, Von Korff M, Koepsell TD et al. A comparison of pain, functional limitations, and work status indices as outcome measures in back pain research. Spine 1999;24:2339–45.
15. Dionne CE, Koepsell TD, Von Korff M, et al. Predicting long-term functional limitations among back pain patients in primary care settings. J Clin Epidemiol 1997;50:31–43.
16. Donelson R, Silva G, Murphy K. Centralization phenomenon: Its usefulness in evaluating and treating referred pain. Spine 1990;15:211–3.
17. Faas A, Chavannes AW, Van Eijk JTM, et al. A randomized, placebo-controlled trial of exercise therapy in patients with acute low back pain. Spine 1993;18:1388–95.
18. Fairbank JCT, Couper J, Davies JB, et al. The Oswestry low back pain disability questionnaire. Physiotherapy 1980;66:271–3. 19. Fishbain DA, Abdel-Moty E, Cutler R, et al. Measuring residual functional capacity in chronic low back pain patients based on the Dictionary of Occupational Titles. Spine 1994;19:872–80.
19. Fishbain DA, Abdel-Moty E, Cutler R, et al. Measuring residual functional capacity in chronic low back pain patients based on the Dictionary of Occupational Titles. Spine 1994;19:872–80.
20. Fritz JM, Delitto A, Vignovic M, et al. Interrater reliability of judgments of the centralization phenomenon and status change during movement testing in patients with low back pain. Arch Phys Med Rehabil 2000;81:57–61.
21. Fritz JM, George S. The use of a classification approach to identify subgroups of patients with acute low back pain. Interrater reliability and short-term treatment outcomes. Spine 2000;25:106–14.
22. Frymoyer JW. Predicting disability from low back pain. Clin Orthop 1992; 279:101–9.
23. Gatchel RJ, Polatin PB, Kinney RK. Predicting outcome of chronic back pain using clinical predictors of psychopathology: A prospective analysis. Health Psychol 1995;14:415–20.
24. Hall H, McIntosh G, Melles T, et al. Effect of discharge recommendations on outcome. Spine 1994;19:2033–7.
25. Hasenbring M, Marienfeld G, Kuhlendahl D, et al. Risk factors of chronicity in lumbar disc patients A prospective investigation of biologic, psychologic, and social predictors of therapy outcome. Spine 1994;24:2759–65.
26. Hazard RG, Haugh LD, Reid S, et al. Early prediction of chronic disability after occupational low back injury. Spine 1996;21:945–51.
27. Hensher D, Johnson LW. Applied Discrete Choice Modeling. London: Crom Helm, 1981.
28. Hosmer DW, Semeshow S. Applied Logistic Regression. New York, NY: John Wiley & Sons, 1989. 29. Israel BA, House JS, Schurman SJ, et al. The relation of personal resources, participation, influence, interpersonal relationships, and coping strategies to occupational stress, job strains and health: A multivariate analysis. Work Stress 1989;3:163–93.
29 Israel BA, House JS, Schurman SJ, et al. The relation of personal resources, participation, influence, interpersonal relationships, and coping strategies to occupational stress, job strains and health: A multivariate analysis. Work Stress 1989;3:163–93.
30. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: A comparison of six methods. Pain 1986;27:117–26.
31. Karas R, McIntosh G, Hall H, et al. The relationship between nonorganic signs and centralization of symptoms in the prediction of return to work for patients with low back pain. Phys Ther 1997;77:354–60.
32. Keefe FJ, Wilkins RH, Cook WA. Direct observation of pain behaviour in low back pain patients during physical examination. Pain 1984;20:59–68.
33. Klenerman L, Slade PD, Stanley IM, et al. The prediction of chronicity in patients with an acute attack of low back pain in a general practice setting. Spine 1995;20:478–84.
34. Lehmann TR, Spratt KF, Lehmann KK. Predicting long-term disability in low back injured workers presenting to a spine consultant. Spine 1993;18: 1103–12.
35. Long A. The centralization phenomenon: its usefulness as a predictor of outcome in conservative treatment of low back pain (a pilot study). Spine 1995;20:2513–21.
36. McKenzie R. The Lumbar Spine: Mechanical Diagnosis and Therapy. Waikanae, New Zealand: Spinal Publication Ltd, 1981;43–8.
37. McIntosh G, Frank J, Hogg-Johnson S, et al. Prognostic factors for time receiving workers' compensation benefits in a cohort of patients with low back pain. Spine 2000;25:147–57.
38. Nordin M, Skovron ML, Hiebert R, et al. Early predictors of delayed return to work in patients with low back pain. J Musculoskel Pain 1997;5:5–27.
39. Riddle DL, Stratford PW. Interpreting validity indexes for diagnostic tests: An illustration using the Berg Balance Test. Phys Ther. 1999;79:939–48.
40. Roland M, Morris R. A study of the natural history of low back pain: Part 1. Development of a reliable and sensitive measure of disability in low back pain. Spine 1983;8:141–4.
41. Spitzer WO, LeBlanc FE, Dupuis M. Scientific approach to the assessment and management of activity-related spinal disorders. Spine 1987;12:S1–S59.
42. Spratt K, Lehmann T, Weinstein J, et al. A new approach to the low back physical examination: Behavioral assessment of mechanical signs. Spine 1990;15:96–102.
43. Sufka A, Hauger B, Trenary M, et al. Centralization of low back pain and perceived functional outcome. J Orthop Sports Phys Ther 1998;27:205–12.
44. Stratford P, Spadoni G, Berk A. Selecting the best clinical diagnostic test. Orthopaedic Practice 1999;11:30–35. 45. Tate RB, Yassi A, Cooper J. Predictors of time loss after back injury in nurses. Spine 1999;24:1930–6.
45. Tate RB, Yassi A, Cooper J. Predictors of time loss after back injury in nurses. Spine 1999;24:1930–6.
46. Von Korff M, Saunders K. The course of back pain in primary care. Spine 1996;21:2833–39.
47. Von Korff M. Studying the natural history of back pain. Spine 1994; 19(Suppl 18):2041S–6S.
48. Von Korff M, Deyo RA, Cherkin D, et al. Back pain in primary care. Outcomes at 1 year. Spine 1993;18:855–62.
49. Waddell G. The Back Pain Revolution. Edinburgh: Churchill Livingston, 1998.
50. Waddell G, Newton M, Henderson I, et al. A Fear–Avoidance Beliefs Questionnaire (FABQ), the role of fear–avoidance beliefs in chronic low back pain and disability. Pain 1993;52:157–68.
51. Waddell G, Richardson J. Observation of overt pain behaviour by physicians during routine clinical examination of patients with low back pain. J Psychosom Res 1992;36:77–87.
52. Werneke MW, Hart DL, Cook D. A descriptive study of the centralization phenomenon: A prospective analysis. Spine 1999;24:676–83.
53. Wilson L, Hall H, McIntosh G, et al. Inter-tester reliability of a low back pain classification system. Spine 1999;24:248–54.

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# Point of View

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Prior work has suggested a positive association between centralization and "good" clinical outcomes.[1,2] This study suggests that the lack of centralization may be moderately predictive of increased odds for chronic pain symptoms and disability. In this regard, the lack of centralization may be seen as a "yellow flag," a sign of caution that the patient may not recover in the manner predicted by natural history.

It could be argued that without a comparison group, this study merely demonstrates that the lack of centralization predicts a lack of response to McKenzie treatment, not necessarily a poor outcome. This should be studied further.

Interpreting odds ratios is often challenging in this context. Chance can be measured by either odds or probabilities. Because most people think in probabilities, not odds, misinterpretation is not uncommon. When we say, for example, that an event is "five times more likely to occur in group A than in group B," we are referring relative risk, not the relative odds (or odds ratio). In situations where the absolute rate for the outcome of interest (in this case disability) is rare, *i.e.*, less than 10%, odds ratios (OR) are a good approximation of relative risk (RR). If the outcome is more common, however, the OR may exaggerate the association between the exposure (*e.g.*, centralization) and the outcome (*e.g.*, disability). The greater the rate of the outcome of interest, the greater the exaggeration.

In this study, the absolute rates of disability, that is, 'how many of the centralizers and noncentralizers were still disabled at 12 months?' is not known. If disability is common (>10–20%), the odds ratios presented may, have exaggerated the association. For example if the disability rate is 50%, an odds ratio of 5 is equivalent to a true RR of only 2.9. This would certainly still be of interest, although not as dramatic.

Figure 1 below illustrates this divergence between OR and RR as the rate for the outcome of interest increases. Here, the OR is fixed at 6.0. One then can calculate the risk of an event in group x and event in group y from the odds of x and odds of y by risk x = odds x/(1 + odds x) and risk y = odds y/(1 + odds y). Then the RR = (risk x)/(risk y).[3,4]

## References

1. Donelson R, Murphy K, Silva G. Centralization phenomenon: Its usefulness in evaluating and treating referred pain. Spine. 1990;15:211–213.
2. Long A. The centralization phenomenon: Its usefulness as a predictor of outcome in conservative treatment of chronic low back pain. Spine. 1995;29: 2513–20.
3. Welch HG. Primer on absolute versus relative differences. Effective Clinical Practice. 2000;3:46.
4. Welch HG. Primer on probability and odds and interpreting their ratios. Effective Clinical Practice. 2000;3:145–6.

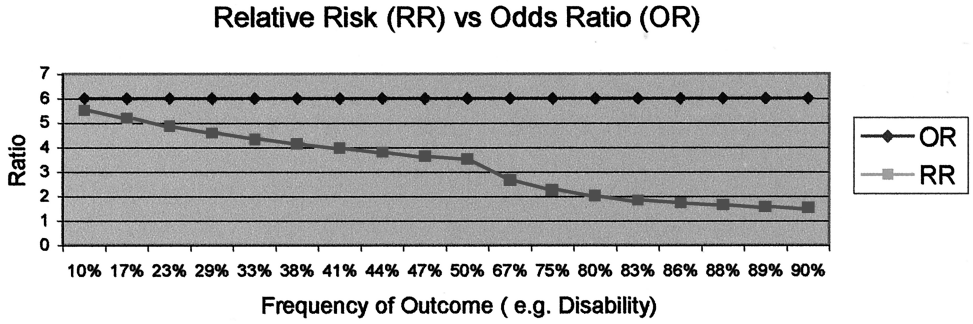


Figure 1. Holding the odds ratio (◆) constant at 6.0, note the widening discrepancy from the relative risk (■) as the frequency of the outcome (in this case disability on the x-axis) increases. (The author thanks Brett Hansom for his assistance with Figure 1.)