

Prognostic Factors Associated With Minimal Improvement Following Acute Whiplash-Associated Disorders

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Study Design. Retrospective clinical cohort study.

Objective. To identify the prognostic factors associated with a poor response to treatment in the early stages of a whiplash-associated disorder (WAD).

Summary of Background Data. Several demographic and clinical factors related to recovery following acute WADs have been identified. However, few longitudinal studies have investigated a multivariable model of recovery that includes socio-demographic, treatment, clinical, and nonclinical factors.

Methods. A study cohort of 2,185 patients with acute or subacute WADs presenting to 48 rehabilitation clinics in 6 Canadian provinces were investigated for factors associated with failure to demonstrate a minimally important clinical change (10%) in the Canadian Back Institute Questionnaire (CBIQ) score between the initial and discharge rehabilitation visits.

Results. Multivariable analysis revealed eight prognostic factors associated with a negative outcome: 1) older age, 2) female gender, 3) increasing lag time between injury date and presentation for treatment, 4) initial pain location, 5) province of injury, 6) higher initial pain intensity, 7) lawyer involvement, and 8) at work at entry to the clinic. The effect of lawyer involvement was stronger for patients with less intense pain on initial visit (odds ratio = 2.97; 95% confidence interval, 1.77–4.99). Similarly, the effect of work status was stronger for patients with less intense pain on initial visit (odds ratio = 2.02; 95% confidence interval, 1.18–3.46).

Conclusions. Researchers and clinicians should be aware of the potential for non-injury-related factors to delay recovery, and be aware of the interaction between the initial intensity of a patient's pain and other covariates when confirming these results.

Key words: whiplash, whiplash-associated disorder, epidemiology, prognosis, recovery. **Spine 2006;31:E759–E765**

A number of factors are associated with disability following acute whiplash-associated disorders (WADs). The literature consistently shows that female gender,^{1–4} older age,^{1,2,4,5} increasing grade of injury by the Quebec Task Force (QTF) classification,^{1–3,6} initial intensity of neck pain and headache,^{4,5,7} radicular signs and symptoms, and previous neck pain^{3–5} are associated with delayed recovery. However, the lack of consistency and limited findings on many other potentially important prognostic variables has generated considerable controversy. The multifactorial nature of recovery after a WAD warrants further exploratory investigation of demographic, clinical, treatment, and nonclinical factors.

Overall, the natural history of whiplash is generally thought to be favorable,⁸ but recent research has highlighted the unpredictable course of recovery⁴ and evidence suggests that disability may be related in some cases to external, nonclinical factors.^{1,9–11} Indeed, depending on the insurance jurisdiction as few as 2% (Quebec) and as many as 30% (Saskatchewan) of Canadians involved in a crash are still compensated 1 year after their collision.^{9,10} However, both Quebec and Saskatchewan operate under a no-fault system (where pain and suffering are not compensated) suggesting other important compensation policy factors might further explain the observed differences in claim durations. Similar variability has been observed in other parts of the world. For example, a population-based study of 210 Lithuanian subjects suggests that the median duration of neck pain following acute whiplash is 3 days,¹¹ while a Swiss study in primary care patients indicates that 56% of patients are asymptomatic at 3 months while 82% are symptom free at 2 years.¹²

The purpose of this study was to investigate prognostic factors for WAD using a multivariable model that

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included demographic, clinical, treatment, and nonclinical factors.

■ Materials and Methods

The cohort study included 2,185 individuals injured in motor vehicle collisions (MVC) and enrolled in rehabilitation clinics in 6 provinces across Canada between January 1, 1998 and December 31, 2001. The vast majority of patients were referred by their physician, although self-referral was also possible. This study was an analysis of an existing clinical database of a national rehabilitation provider, Canadian Back Institute (CBI). Patients within the database were included in the study if they 1) were adults 18 to 65 years of age with neck or low back pain after a MVC, 2) presented for rehabilitation services in the acute or subacute stage (less than or equal to 91 days since their injury)^{13,14} 3) completed both the entry and discharge patient questionnaires, and 4) completed the Visual Analogue Scale (VAS) for intensity of their pain at initial visit. Patients presenting with chronic injury (>91 days since injury) or previous spinal surgery were excluded from the study sample.

Each patient completed the Canadian Back Institute Questionnaire (CBIQ)¹⁵ providing socio-demographic and injury characteristics at the time of their initial visit. A standardized assessment (physical examination and history) by a registered physiotherapist was also performed during the initial clinical visit. After the treatment period, discharge from the clinic occurred and all patients completed the CBIQ again to document changes in their condition. Discharge occurred at the point when the physician, therapist, or patient deemed the patient sufficiently recovered. As a result, the criteria for discharge is based on professional judgment and probably varied across study participants. Delayed recovery could also result in referral from CBI to another clinical setting. Assessment procedures, data collection, and treatment during the study period were standardized across the treatment centers. The database questionnaire and physical assessment data made available to the research team by CBI Health were governed by a data agreement for research purposes. The study protocol was approved by the Clinical Research Ethics Board, University of British Columbia.

The primary study outcome was a minimally important clinical change in the score for the CBIQ between the initial and discharge rehabilitation visits defined as a 10% change, or 6.1 points.¹⁶ The CBIQ is a modified version of the Low Back Outcome Score with a maximum score of 61 points, and it includes 19 items on disability (*e.g.*, how pain affects ability to sit, stand, and other daily activities). The CBIQ correlates well with the Oswestry Disability Index (Pearson correlation coefficient (r) = -0.72), and has demonstrated the ability to predict prognosis.¹⁷ For the purposes of this study, the questionnaire was rescaled to remove the lawyer retention question from the total score, as this variable was of interest as an independent predictor in the analytic models.

A total of 25 prognostic factors (Tables 1–3) were included in the analytical models, grouped into three categories defined as personal and nonclinical characteristics (*e.g.*, age, compensation jurisdiction, lawyer involvement), treatment characteristics (*e.g.*, duration of treatment, previous treatments), and clinical characteristics (*e.g.*, location of pain, number of symptoms, comorbid conditions and initial pain intensity). There were approximately 90 subjects per independent variable, thereby exceeding the recommended minimum of 10 to 20 subjects per variable suggested for adequate sample size to support regression analysis.¹⁸

Logistic regression modeling using a 3-stage manual approach¹⁹ was used to evaluate associations between prognostic factors and the minimally clinically important change in the CBIQ, after adjusting for initial CBIQ score. First, explanatory variables achieving a P value <0.10 on the Wald statistic¹⁹ at the univariate level were retained. Second, retained variables were entered into multivariable, category-specific models. Once again, the variables that achieved a P value <0.10 were retained. Third, all remaining variables were entered into a multivariable model (all categories) and variables with a P value <0.05 were retained. Using this model as a base, additional models were fit with interaction terms. Predicted probabilities for the outcome were generated using leave-one-out cross-validation for each of the competing provisional models,¹⁸ and the corresponding receiver operator characteristic (ROC) curves were constructed to choose the best predictive model (defined as the model yielding the largest area under the ROC curve). Our results are presented as adjusted odds ratios and their 95% confidence intervals. A comparison of the predicted and the observed responses in deciles of risk was conducted for the final model using the Hosmer and Lemeshow goodness-of-fit statistic.¹⁹ All analyses were conducted using SAS System for Windows version 8.2 or S-Plus 2000 for Windows.

■ Results

The extraction of data from the clinical database produced an initial list of 16,404 WAD patients injured in a MVC and treated at 1 of 48 participating clinics across the country during the study period. Of these patients, 8,945 (54.5%) had acute or subacute WAD (presented within 91 days of injury). Complete follow-up information was available for 3,472 (38.8%) patients. The exclusion of individuals with previous injuries and missing data resulted in a final study population of 2,185 patients (Figure 1).

The mean age of the cohort was 35.6 years (Table 1). Just over half of the participants were female (55.3%) and were off work due to their MVC, and over one third (38.3%) had retained a lawyer at some point before their discharge from CBI. The mean time between the injury date and the presentation to the clinic was 31.7 days. Almost 30% (29.7%) of the patients had a primary complaint of neck pain, 55.9% had both neck and low back pain, while the remainder (14.4%) reported only low back pain (Table 2). The average initial pain intensity rating was 6.0 (range, 0–10; SD, 2.0). The average duration of the treatment program at CBI was 72.7 days, and during this time the patients received an average of 22.9 rehabilitation/treatment sessions (SD, 16.5) (Table 3).

Those individuals who responded to both the entry and exit questionnaires ($n = 3472$) compared with those who did not ($n = 5,473$) were less likely to smoke (34.4% of the respondents *vs.* 39.6% of the nonrespondents, $P < 0.001$) or have a comorbid medical condition (8.3% *vs.* 10.9%, $P < 0.001$), and their duration treatment was longer (72.1 day *vs.* 61.7 days, $P < 0.001$). Patients reporting a VAS score on initial presentation ($n = 2,185$) compared with those who did not ($n = 875$) were more likely to have hired a lawyer (30.7% *vs.* 27%, $P = 0.004$), less likely to have taken time off work due to

Table 1. Personal and Nonclinical Characteristics of 2,185 Patients With Acute Presentation After a Motor Vehicle Collision

| Personal Characteristics | Total Population (n = 2,185) | Positive Outcome ($\geq 10\%$ change in questionnaire score) (n = 1,574) | Negative Outcome ($< 10\%$ change in questionnaire score) (n = 611) |
|---|---------------------------------|--|---|
| Age | | | |
| Mean age (yr) (SD) | 35.6 (10.6) | 35.3 (10.5) | 36.4 (10.8) |
| Gender [no. (%)] | | | |
| Male | 977 (44.7) | 731 (46.4) | 246 (40.3) |
| Female | 1208 (55.3) | 843 (53.6) | 365 (59.7) |
| Smoking status [no. (%)] | | | |
| Current/former | 778 (35.6) | 588 (37.4) | 190 (31.1) |
| Nonsmoker | 1407 (64.4) | 986 (62.6) | 421 (68.9) |
| Work status due to collision [no. (%)] | | | |
| Off work | 1166 (53.4) | 904 (57.4) | 262 (42.9) |
| At work at entry to the clinic | 1019 (46.6) | 670 (42.6) | 349 (57.1) |
| Physical demands of work [no. (%)] | | | |
| Sedentary | 363 (16.6) | 253 (16.1) | 110 (18.0) |
| Light | 370 (16.9) | 256 (16.3) | 114 (18.7) |
| Medium | 514 (23.5) | 373 (23.7) | 141 (23.1) |
| Heavy | 668 (30.6) | 514 (32.7) | 154 (25.2) |
| Missing | 270 (12.4) | 178 (11.3) | 92 (15.1) |
| Province [no.(% entire sample, provincial)]* | | | |
| British Columbia | 635 (29.1, 100) | 438 (27.8, 69.0) | 197 (32.2, 31.0) |
| Alberta | 510 (23.3, 100) | 335 (21.3, 65.7) | 175 (28.6, 34.3) |
| Saskatchewan | 72 (3.3, 100) | 50 (3.2, 69.4) | 22 (3.6, 30.6) |
| Ontario | 822 (37.6, 100) | 624 (39.6, 75.9) | 198 (32.4, 24.1) |
| Quebec | 31 (1.4, 100) | 25 (1.6, 80.6) | 6 (1.0, 19.4) |
| Nova Scotia | 115 (5.3, 100) | 102 (6.5, 88.7) | 13 (2.1, 11.3) |
| Lag time between injury date and clinic presentation | | | |
| Mean duration (days) (SD) | 31.7 (23.7) | 30.3 (23.2) | 35.4 (24.7) |
| Median | 25.0 | 23.0 | 30.0 |
| Retained a lawyer on or before first visit to clinic [no. (%)] | | | |
| Yes | 672 (30.8) | 477 (30.3) | 195 (31.9) |
| No | 1513 (69.2) | 1097 (69.7) | 416 (68.1) |
| Retained a lawyer at some point prior to discharge [no. (%)] | | | |
| Yes | 837 (38.3) | 561 (35.6) | 276 (45.2) |
| No | 1348 (61.7) | 1013 (64.4) | 335 (54.8) |

*Provincial % represents the data stratified by province.

their injuries (53.4% vs. 63.9%, $P < 0.001$), less likely to have comorbid medical conditions (5.5% vs. 11.7%, $P < 0.001$), and less likely to have had previous treatment (9.1% vs. 22.4%, $P < 0.001$). The remaining observed differences between respondents and nonrespondents were small and clinically insignificant.

In total, 1,574 of the 2,185 patients (72.0%) demonstrated a minimally clinically important improvement between initial visit and discharge as measured by the CBIQ. The mean change in raw score for the entire cohort was 13.5 points (SD, 11.0; median, 13).

Table 4 shows the adjusted effect estimates (ORs) for the final predictive model, chosen based on having the largest area under the ROC curve (area under the curve = 0.72) during model validation. Leave-one-out cross-validation compared the association of the predicted probabilities and observed responses and revealed 73.4% concordant pairs. For this final model, the area under the curve was 0.74, with a sensitivity of 0.78 and specificity of 0.51. The Hosmer and Lemeshow goodness-of-fit statistic was not significant ($P = 0.24$), indicating validity of the model.

In the final model, increasing age, female gender, increasing lag time from injury to initial rehabilitation visit, neck pain, and initial pain intensity were significantly associated with a negative outcome. Two of the compensation jurisdictions (Ontario and Nova Scotia) were associated with a decreased risk of a negative outcome compared with British Columbia. Lawyer retention and work status (at work at entry to the clinic) were the strongest predictors of a negative outcome and these effects were modified by initial pain intensity. The effect of lawyer retention was stronger for patients with less intense pain on initial visit (OR, 2.97; 95% CI, 1.77–4.99). Similarly, the effect of working was stronger for patients with less intense pain on initial visit (OR, 2.02; 95% CI, 1.18–3.46).

■ Discussion

The identification of prognostic factors for early recovery after an MVA is an important step in understanding and potentially reducing the burden of illness created by WADs. This study found a number of factors associated with poor recovery in the secondary care setting (physiotherapy). The association of increasing age^{4,8} and gen-

Table 2. Clinical Characteristics of 2,185 Patients With Acute Presentation After a Motor Vehicle Collision

| Clinical Characteristics | Total Population (n = 2,185) | Positive Outcome ($\geq 10\%$ change in questionnaire score) (n = 1,574) | Negative Outcome ($< 10\%$ change in questionnaire score) (n = 611) |
|-------------------------------------|---------------------------------|--|---|
| Location of pain [no. (%)] | | | |
| Neck | 649 (29.7) | 480 (30.5) | 169 (27.7) |
| Neck and back | 1222 (55.9) | 850 (54.0) | 372 (60.9) |
| Back | 314 (14.4) | 244 (15.5) | 70 (11.5) |
| Other area affected [no. (%)] | | | |
| Headache | 613 (28.1) | 441 (28.0) | 172 (28.2) |
| Mid-back | 960 (43.9) | 696 (44.2) | 264 (43.2) |
| Upper extremity | 335 (15.3) | 249 (15.8) | 86 (14.1) |
| Lower extremity | 274 (12.5) | 192 (12.2) | 82 (13.4) |
| No. of symptoms | | | |
| Mean no. (SD) | 2.6 (1.3) | 2.5 (1.3) | 2.6 (1.2) |
| Median | 2.0 | 2.0 | 2.0 |
| Neurologic tests [no. (%)] | | | |
| Positive | 33 (1.5) | 23 (1.5) | 10 (5.6) |
| Negative | 2152 (98.5) | 1551 (98.5) | 601 (94.4) |
| Nonorganic signs [no. (%)] | | | |
| 3+ | 127 (5.8) | 93 (5.9) | 34 (5.6) |
| Comorbid conditions [no. (%)] | | | |
| Yes | 256 (11.7) | 173 (11.0) | 83 (13.6) |
| No | 1929 (88.3) | 1401 (89.0) | 528 (86.4) |
| Initial pain intensity (range 0–10) | | | |
| Mean intensity VAS (SD) | 6.0 (2.0) | 6.1 (2.0) | 5.9 (2.0) |
| Median | 6.0 | 6.0 | 6.0 |

der^{3,4,9} with slower recovery observed in this study has been demonstrated in previous studies investigating whiplash recovery outcomes. Patients who waited the longest to seek treatment following their injury were less likely to demonstrate improvement during the follow-up period. Each additional month of lag time was associated with an approximate 20% increase in the odds of a poor outcome. Several sources support an early, active approach to treatment for WAD.^{8,20,21} In those individuals where there was a delay before their initial visit to the clinic, behavioral and psychological consequences of a WAD may have resulted in a poor recovery outcome.

We found that injuries to the neck, with or without low back pain, were associated with a poor outcome. Depending on the study, various post collision symp-

toms, such as neck pain on palpation,² headache,²² upper back pain,⁵ low back pain,²³ radicular symptoms,⁴ and number of total symptoms⁵ have been associated with delayed recovery or poor outcome. Generally, those individuals with more body areas affected would likely demonstrate increased disability. It is reasonable to expect that these individuals have a more serious condition and may take longer to heal. In this regard, those patients in the current study with simultaneous neck and back pain were more likely to have a poor outcome.

A higher percentage of patients from Ontario and Nova Scotia demonstrated a positive outcome in comparison to the reference category, British Columbia. The reasons for the association between clinical improvement and province have not been established clearly. The

Table 3. Treatment-Related Characteristics of 2,185 Patients With Acute Presentation After a Motor Vehicle Collision

| Treatment-Related Characteristics | Total Population (n = 2,185) | Positive Outcome ($\geq 10\%$ change in questionnaire score) (n = 1,574) | Negative Outcome ($< 10\%$ change in questionnaire score) (n = 611) |
|-----------------------------------|---------------------------------|--|---|
| Duration of treatment program | | | |
| Mean duration (days) (SD) | 72.7 (64.6) | 72.6 (65.3) | 72.8 (62.8) |
| Median | 56.0 | 55.0 | 58.0 |
| No. of treatment sessions | | | |
| Mean no. (SD) | 22.9 (16.5) | 22.9 (16.9) | 22.9 (15.4) |
| Median | 20.0 | 20.0 | 20.0 |
| Previous investigations [no. (%)] | | | |
| X-rays | 594 (27.2) | 438 (27.7) | 156 (25.5) |
| Other | 45 (2.1) | 33 (2.1) | 12 (2.0) |
| Previous treatment [no. (%)] | | | |
| Yes | 490 (22.4) | 332 (21.1) | 158 (25.9) |
| No | 1695 (77.6) | 1242 (78.9) | 453 (74.1) |
| Concurrent treatment [no. (%)] | | | |
| Yes | 217 (9.9) | 152 (9.7) | 65 (10.6) |
| No | 1968 (90.1) | 1422 (90.3) | 546 (89.4) |
| Health care seeking | | | |
| Mean no. (SD) | 1.6 (0.9) | 1.6 (0.9) | 1.6 (0.9) |
| Median | 1.0 | 1.0 | 1.0 |

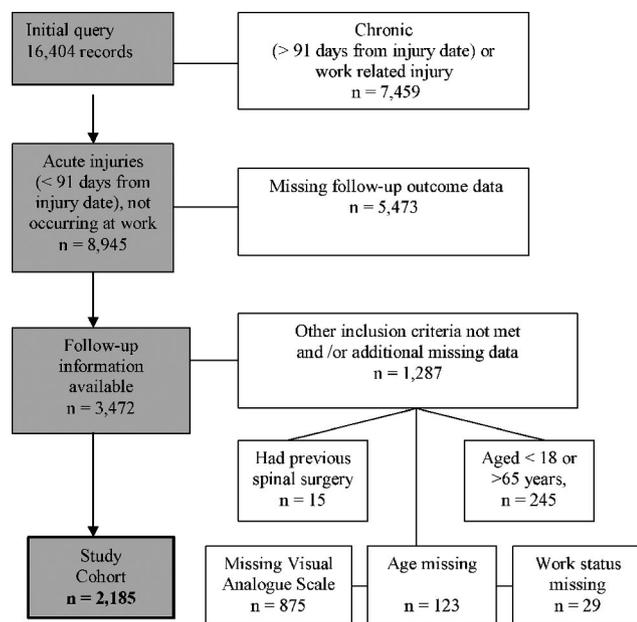


Figure 1. Final working data set of individuals injured in a motor vehicle collision attending a Canadian Back Institute clinic in Canada between 1998 and 2001.

Quebec Task Force on Whiplash-Associated Disorders (QTF) suggested that the insurance jurisdiction could alter prognosis.⁸ This effect was subsequently confirmed in the province of Saskatchewan when the introduction

Table 4. Adjusted Effect Estimates (Odds Ratios and 95% CIs) for Predictors of Negative Outcome After a Whiplash-Associated Disorder Among a Cohort of MVC Patients

| Variable | Adjusted Odds Ratio (95% CI) |
|--|---------------------------------|
| Age (per decade) | 1.21 (1.09–1.32) |
| Gender: female | 1.36 (1.08–1.59) |
| Lag time (per month) | 1.20 (1.06–1.39) |
| Pain location | |
| Neck and back vs. back | 1.69 (1.23–2.34) |
| Neck vs. back | 1.06 (0.74–1.03) |
| Province | |
| Alberta vs. British Columbia | 0.78 (0.58–1.03) |
| Saskatchewan vs. British Columbia | 0.84 (0.47–1.48) |
| Ontario vs. British Columbia | 0.54 (0.41–0.71) |
| Quebec vs. British Columbia | 0.81 (0.31–2.07) |
| Nova Scotia vs. British Columbia | 0.21 (0.11–0.40) |
| Lawyer retention stratified by pain intensity* | |
| Mild intensity (VAS 0–4) | 2.97 (1.77–4.99) |
| Moderate intensity (VAS 5–7) | 2.41 (1.74–3.34) |
| Severe intensity (VAS 8–10) | 1.73 (1.27–2.66) |
| Work status (at work at entry to the clinic) | |
| Mild intensity (VAS 0–4) | 2.02 (1.18–3.46) |
| Moderate intensity (VAS 5–7) | 0.90 (0.65–1.26) |
| Severe intensity (VAS 8–10) | 0.74 (0.45–1.19) |

*Adjusted OR (95% CI) for initial pain intensity without the interaction terms = 1.08 (1.03–1.15).

†Results from preliminary univariate analysis not shown; variables discarded due to nonsignificance during univariate analysis include: smoking status, physical demands at work, headache, mid-back pain, upper extremity pain, lower extremity pain, mean no. of symptoms, positive neurologic testing, 3+ nonorganic signs, comorbid medical conditions, duration of treatment, no. of treatment sessions, previous x-ray, previous other investigations, previous treatment, concurrent treatment, health care seeking.

of no-fault legislation eliminating pain and suffering compensation resulted in faster claims closure.⁹ Previous reports have also highlighted that a large variation in recovery time (as determined by a reduction in whiplash symptoms) exists even within jurisdictions with common insurance systems.^{1,12} During the study period, British Columbia, Alberta, and Nova Scotia operated under tort insurance systems. Ontario's insurance system contained aspects of a tort system. The provinces of Saskatchewan and Quebec operated under no-fault insurance systems. It is impossible to determine from these data how the complex interaction of factors determined by insurance policy may have altered the clinical course and prognosis of those injured in a MVC; however, this study found the province as an indicator of (surrogate for) insurance policies, to be an important predictor of outcome.

The inclusion of the intensity variable revealed two significant interaction terms. The initial pain intensity (VAS) variable interacted with both lawyer retention and current work status. In individuals with mild (VAS 0–4) and moderately (VAS 5–7) intense pain at initial presentation, this study found that the retention of a lawyer was associated with a lack of meaningful improvement. A similar effect has been described in individuals recovering from a closed head injury.²⁴ Binder and Rohling reported that the impact of financial incentives on disability and maintenance of symptoms was most pronounced in individuals with minor injuries.²⁴ Individuals with minor disability and pain may report less improvement, as any medical improvement could impact future compensation through litigation. As well, when initial disability and pain are more intense, there is more room for clinical improvement, perhaps without the perception that future compensation will be affected.

It is not clear why the strength of the association between work status and a clinically important improvement increased as the initial pain intensity decreased. This is likely related to the precision of the CBIQ to measure change in individuals with minimal disability (*i.e.*, mild intensity pain and remained at work). In comparison, a patient with a mild initial pain intensity level who was off work and receiving compensation for lost wages might appear to be more disabled on the CBIQ simply because of the added effect of the work disability. In this context, nonworking patients also have more room for improvement in comparison with their working counterparts, and are therefore more likely to have demonstrated and reported a clinical improvement. It is also possible that individuals who were not able to take time off work following their injury were not able to fully participate in rehabilitation programs and/or have may have had certain job demands that led to aggravation of their symptoms.

The restriction of our study population to acute patients at a similar stage of recovery is an appropriate strategy for investigating disability outcomes after WAD and also reduces various misclassification biases.^{8,25} This study included only those patients whose lag time be-

tween injury date and treatment start date was under 91 days. This period may allow for the accumulation of some subacute cases; however, with a median lag time of 25 days (mean, 32 days) in our study, most patients were still in an acute state.

Common outcome measures used in previous prognosis studies of acute whiplash have been the time-to-claim closure or the self-report of the presence of whiplash symptoms.⁴ Although time-to-claim closure has been shown to be a good indicator of recovery from WAD,^{7,9} it is criticized by some authors.²⁶ Alternatively, self-reported whiplash-related symptoms are often used in studies; however, in addition to the recall bias introduced when asking one to remember past symptoms, previous studies rarely use a standardized instrument designed to measure pain and/or disability. In the current study, the primary outcome was a change in disability questionnaire score between entry to and discharge from the clinic. A clinically important change in score indicated that a patient had demonstrated at least a minimal improvement in their condition. The data were collected in a standardized manner using a valid and reliable instrument.

A potential limitation of using a change in questionnaire score as the primary outcome is the ability of the questionnaire to measure change in individuals with minimal disability. Overall, a total of 30 individuals presented with minimal initial disability such that the primary outcome was not measurable (*i.e.*, of the possible 61 points on the questionnaire, these individuals scored greater than 55 points at initial presentation, thereby making positive outcome impossible). Because of the small numbers, it is unlikely these individuals biased the results in any way.

Individuals with mild forms of WAD may not seek treatment or may not be referred by their physicians to a CBI clinic. These patients would therefore not be included in the CBI database and thus would be excluded from this study. The effect of these referral patterns would be to increase patient homogeneity, thereby narrowing predictor variable distribution, resulting in a bias toward the null.²⁷

Although this study analyzed a large variety of personal, clinical, and treatment-related factors, other prognostic factors that may predict poor outcome, such as depressive symptomatology⁷ and initial health care provider,⁹ were not collected. It is possible that these or other unmeasured factors influenced the described associations.

A potential limitation associated with the use of administrative data for research purposes is the applicability of data fields, when data are being collected for other purposes. The database used for this study was designed for research as well as administrative purposes; thus, we were not limited by data quality issues of this sort. However, despite the overall large sample size of this study sample with WAD, a significant number of subjects were excluded due to missing data. There were minimal differences between those that were included in the study

and those that were not, as outlined in the results. Furthermore, controlling for these factors in the final model did not result in significant changes to the odds ratios of the variables in the model.

■ Conclusion

This study has provided valuable insights into the early stages of recovery from whiplash injuries of varying severity, across multiple insurance jurisdictions. In addition to socio-demographic, clinical, and treatment factors, the current study and other recent literature^{9,28} now provide evidence that lawyer involvement with the case, and provincial system of compensation are important in WAD recovery. Future researchers should consider the interaction that initial pain intensity has with the retention of legal services and work status, and consider other potential interactions that might occur based on the intensity of initial complaints.

■ Key Points

- A cohort of 2,185 patients in the early stages of their injury was analyzed for prognostic factors associated with a poor response to treatment after a whiplash injury.
- Non-injury-related factors, such as lawyer retention, province of injury, and work status, were associated with delayed recovery.
- Researchers should consider the interaction of initial pain intensity with the retention of legal services and work status in future studies.

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