Recovery in Whiplash-Associated Disorders: Do You Get What You Expect?

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ABSTRACT. ***Objective.*** Positive expectations predict better outcome in a number of health conditions, but the role of expectations in predicting health recovery after injury is not well understood. We investigated whether early expectations of recovery in whiplash associated disorders (WAD) predict subsequent recovery, and studied the role of "expectations" to predict recovery as determined by pain cessation and resolution of pain-related limitations in daily activities.

Methods. A cohort of 6,015 adults with traffic-related whiplash injuries was assessed, using multivariable Cox proportional hazards analysis, for association between these expectations and self-perceived recovery over a 1-year period following the injury. Recovery was assessed using 3 indices: self-perceived global recovery (primary outcome); resolution of neck pain severity; and resolution of pain-related limitations in daily activities.

Results. After adjusting for the effect of sociodemographic characteristics, post-crash symptoms and pain, prior health status and collision-related factors, those who expected to get better soon recovered over 3 times as quickly (hazard rate ratio = 3.62, 95% confidence interval 2.55-5.13) as those who expected that they would never get better. Findings were similar for resolution of pain-related limitations and resolution of neck pain intensity, although the effect sizes for the latter outcome were smaller.

Conclusion. Patients' early expectations for recovery are an important prognostic factor in recovery after whiplash injury, and are potentially modifiable. Clinicians should assess these expectations in order to identify those patients at risk of chronic whiplash, and future studies should focus on the effect of changing these early expectations. (J Rheumatol First Release Feb 15 2009; doi:10.3899/jrheum.080680)

Key Indexing Terms:
EXPECTATION WHIPLASH RECOVERY

It has long been acknowledged that beliefs, attitudes and fears about pain predict pain chronicity in low back pain populations[1-5]. A best evidence synthesis on the prognostic literature on neck pain has recently reported that psychosocial factors are also strongly associated with outcome for both nonspecific neck pain in the general population and for whiplash-associated disorders (WAD)[6-10]. One psychosocial factor of interest is expectation of particular health outcomes. This factor has been found to predict actual health outcomes in a wide range of health conditions. For example, positive expectations have been reported to predict a better health outcome in low back pain and myocardial infarction, and to predict success in weight loss programs[11].

Janzen, *et al* have proposed a pragmatic conceptual model describing the possible role of health expectations in Alzheimer disease[12], and there are theoretical reasons to believe that expectations are also important in health outcomes after a musculoskeletal injury[6,9,10,13]. In fact, several studies have reported delayed return to work in injured workers expecting slower recovery[12,14,15]. Return to work,

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however, is not synonymous with health recovery, since many factors other than health status determine whether and how quickly an injured worker returns to work. Using a more direct measure of recovery in WAD, a recent study reported that initial expectations to make a full recovery were associated with less self-perceived limitations in daily activities 6 months after the crash[16].

Health and health outcome expectations are socially and culturally contingent, that is, they are created by the individual's understanding of the world, and formed in relationship to the social and cultural contexts within which he or she is situated. This process is both longitudinal and cyclical[12]. Yet the term "expectation" is not used uniformly in the current literature, and is sometimes used interchangeably with "self-efficacy," as termed by Bandura[17]. However, Maddux (1999) describes the 2 concepts as different in subtle but important ways: "Self-efficacy" relates to beliefs about the ability to achieve a goal under specific circumstances; whereas an "outcome expectation" refers to the belief that a particular outcome will be achieved[18]. An example is returning to work after a work injury. In this case, "self-efficacy" is the individual's belief that he/she will be able to perform the individual tasks that are the components of the job. "Outcome expectancy" is the individual's global belief in achieving the outcome of "return to work." It should be noted that people may not believe that they will be able to perform all the individual work-related tasks of their job, but may still expect that the overall outcome (return to work) will be achieved.

When the outcome of interest is "recovery," outcome expectancies cannot rely on understanding "health recovery" in the context of musculoskeletal pain and injuries. Individuals appear to ascribe different meanings to the concept of "recovery," as demonstrated by Beaton, *et al*'s studies of workers[19]. Their findings suggest that workers with musculoskeletal injuries variously conceive of "recovery" as (1) involving a pain-free state (which Beaton, *et al* termed "resolution"); (2) a state in which pain and symptoms are present but the person has adjusted his or her life to accommodate and minimize these symptoms (termed "readjustment"); or (3) a state in which the pain and symptoms are "redefined," that is, the person has adapted to living with the disorder ("redefinition"). Consistent with this view, Ottosson, *et al* reported that although improvements in pain and physical functioning (measured by the Medical Outcomes Study Short Form-36) were highly associated with an answer of "yes" to the question of "Do you feel recovered?", persons with WAD did not necessarily require their health or pain level to return to baseline measures before considering themselves to have "recovered"[20]. Thus the term "recovery" has a variety of different meanings that go beyond a simplistic view of pain/symptom cessation and/or return to usual functioning. This has important implications for research whose goal is to examine recovery as an outcome in musculoskeletal disorders.

Our study objective was to determine whether early expectations of recovery in WAD predict actual subsequent recovery. In accordance with the above discussion, "recovery" was assessed in a number of different ways. Our primary recovery outcome was self-assessed global recovery. This is an important index of recovery because it does not require anyone external to the person with WAD to determine what constitutes "recovery" for him or her, and is consistent with the idea that "recovery" is person-specific and related to the individual's particular personal and social context. However, pain cessation and improvements in pain-related limitations are also important aspects of recovery in WAD. Therefore, we also studied the role of "expectations" to predict recovery as determined by pain cessation and resolution of pain-related limitations in daily activities.

MATERIALS AND METHODS

Design and study population. Our study setting was the Canadian province of Saskatchewan, with approximately 1,000,000 residents, universal healthcare coverage and a single motor-vehicle insurer. We included all residents aged 18 or older, who made an injury claim or were treated for a traffic-related WAD between December 1, 1997 and November 30, 1999, and had made their claim within 42 days of the injury. Those reporting collision-related neck pain were considered to be "WAD" cases. We excluded workers' compensation claims (since those persons are covered by a different insurance system), those unable to participate due to language barrier or serious unassociated illnesses, and those with serious injuries (hospitalized more than 2 days).

Sources of data and followup. All data were self-reported, and information from the insurance application formed our baseline data. This claim application was a paper-and-pencil questionnaire, which included items on pre-injury health, demographic and socioeconomic characteristics, post-collision pain intensity and location, post-injury symptoms, and depressive symptomatology. Consenting participants were then followed by structured telephone interviews, which included self-rated global recovery, at approximately 6 weeks, and 3, 6, 9, and 12 months post-collision. Of those who consented to participate in followup, 16.2% dropped out prior to self-reported recovery[21]. Research ethics boards of the University of Saskatchewan and the University of Alberta approved the study.

Measures. We assessed expectations for recovery by asking "Do you think that your injury will…" with response options "get better soon; get better slowly; never get better; don't know." The use of a single question to assess expectation for recovery arises from qualitative studies on expectancies[22] and has been used to assess expectations in previous studies[16,23].

Recovery was measured in 3 ways. Our main index of recovery was a global self-assessment using the question "How well do you feel you are recovering from your injuries?", with response options: (1) "all better (cured)," (2) "feeling quite a bit of improvement," (3) "feeling some improvement," (4) "feeling no improvement," (5) "getting a little worse," and (6) "getting much worse." We defined participants as recovered when they reported feeling "all better (cured)" or "feeling quite a bit of improvement" with no recurrence. This global self-assessment of recovery is consistent with research emphasizing the importance of using patient-centered perspectives in assessing "recovery" in injuries[19]. This question was asked of participants at each followup.

A second index of recovery was self-rated neck pain intensity at followup. Recovery was arbitrarily determined to be a rating of "0" or "1" on an 11-point numerical rating scale, where "0" means no pain at all, and a score of "10" refers to pain as bad as it could be. Although pain ratings of

"0" to "3" on this type of scale are generally considered to be "mild" in nature[24], we chose the scores of "0" or "1" to provide a more conservative measure of recovery. The neck pain intensity question was asked at baseline (the time of the injury claim) and repeated at each followup.

A third index of recovery was self-reported limitations in daily activities, as assessed by the Pain Disability Index (PDI)[25-27]. This is a 7-item questionnaire that assesses pain-related limitations or disruptions in activities of daily living such as home responsibilities, occupation, recreation, and social activities. Scores are summed over the 7 questions and possible scores range from 0 to 70, with 0 indicating no disability in any of the assessed areas and 70 indicating that all the activities which they would normally do have been completely disrupted or prevented by the pain. We arbitrarily chose a score of 0 to indicate recovery, again choosing to be extremely conservative in our choice of cutpoints. The PDI was administered at each followup.

Potential confounders. Potential confounders were measured at baseline on the claim form and included age; sex; marital status; education; family income; employment status; prior neck or back injuries; pre-injury musculoskeletal complaints; overall health the month prior to the injury; comorbid diseases; direction of impact to the vehicle; post-injury neck, low back, and headache pain intensity; extent of body in pain; post-injury symptoms (presence and number); baseline self-perceived disability (see description below); presence of crash-related fractures; self-reported head injuries; need for hospitalization after the injury; health care received after the injury; and self-rated global post-injury health.

Pain intensity (assessed at baseline and each followup interview) was measured using an 11-point numerical rating scale for each region, and a pain drawing (administered only at baseline) was used to calculate the extent of body in pain[28,29]. Pre-collision musculoskeletal complaints and other comorbid medical conditions were assessed at baseline using a self-report measure of health problems[30]. Depressive symptomatology was measured at baseline and at all followup points using the Centre for Epidemiologic Studies Depression Scale (CES-D)[31]. Prior health and post-injury health were assessed at baseline using the following questions, respectively: "How was your health the month *before* the accident?" and "In general, would you say your health is *now* (that is, since the accident)" with the following response options for both questions: "excellent; very good; good; fair; poor." The PDI was administered only at followup interviews, but the initial (baseline) questionnaire included 4 questions about self-perceived disability. These were: "Have the injuries resulting from the accident prevented you from carrying out any of the following activities? (check all that apply): Daily home activities; Employment; Education; Other."

Statistical analysis. We built Cox proportional hazard models to determine the association between expectation for recovery and each index of recovery. We examined the proportionality assumption of our models graphically by plotting the log-log of the survival functions. Subjects were followed until they met our criteria for recovery, to the end of the study, or until they withdrew from the study. Assuming that attrition occurred randomly between each followup period, those who withdrew from the study prior to having recovered were censored half way between the last participation point and the next scheduled interview. For each of the 3 models (one for each index of recovery), we followed the same analysis strategy. We first built a univariate Cox model with expectation for recovery (our exposure variable) as the only independent variable. To identify confounders, we then built a series of bivariate models that tested whether the inclusion of each potential confounder (the variables described above) produced a 10% or greater change in the regression coefficient of the crude association between expectations and recovery[32]. We adjusted for those confounding factors in the final models. Our findings are reported as hazard rate ratios, which measure relative risks. All analyses were completed using SPSS for Windows, version 16.0 and STATA/SE, version 9.1[33,34].

RESULTS

Of the 8,634 claimants during the 2-year inception period, 6,749 met the criteria for WAD, and 6,021 made their claim within 42 days of the injury. Of these, 6 did not answer the expectation question, leaving a study sample of 6,015. Median time between the crash and completion of claim form was 11 days. Characteristics of the study sample, stratified by their expectations to recover, are reported in Table 1. Most (41.9%) expected to get better slowly, 24.4% expected to get better soon, 1.9% expected to never get better, and 31.8% did not know. There was no association between time to complete the claim form and how well individuals expected to recover. Average time to recovery for each measure of recovery was fastest in those who expected to get better soon, followed by those who expected to get better slowly, and slowest in those who expected to never get better (Table 1). At baseline, those with more positive expectations for their recovery had lower pain scores, less depressed mood, better prior health, higher education, and higher family income.

For our first model, which assessed the association between expectations to recover and global self-assessed recovery, 4 factors met our criteria for confounding. These were depressive symptomatology, post-crash self-reported health, initial post-crash neck pain intensity, and initial post-crash low back pain intensity. After adjusting for these confounders, and in comparison with those who expected that they would never get better (our reference category), those who expected to get better soon recovered over 3 and a half times as quickly; those who expected to get better slowly recovered over 2 and a half times as quickly; and those who did not know recovered almost twice as quickly (Table 2). As a sensitivity check, we also built a model that included all possible confounders (listed in Materials and Methods), but this did not appreciably change the above estimates.

We performed the same analyses for the remaining outcomes. For the outcome of recovery of neck pain intensity (that is, achieving a neck pain score of 0 or 1), the following factors were identified as confounders and were adjusted for in the final model: initial post-injury neck pain intensity, initial post-injury headache intensity, and initial post-injury self-assessed health. After adjusting for these confounders, those who expected to get better soon experienced pain recovery 80% more quickly than those who believed they would never recover, those who expected to get better slowly recovered approximately 50% more quickly, and those who didn't know recovered at approximately the same rate as those who expected never to recover (Table 3).

For the outcome of resolution of pain-related limitations (as identified as a PDI score of 0), the following factors confounded the relationship between expectations and recovery, and were adjusted for in the final model: initial post-injury neck, back, and headache pain intensity; initial post-injury percentage of body in pain; sleep disturbances; initial post-injury self-assessed global health; initial post-injury depressive symptomatology; and initial post-injury limitations in

Table 1. Demographic description of the study population and days to self-rated recovery (n = 6,015).

Variables	Get better soon (n = 1470)	Get better slowly (n = 2519)	Do not know (n = 1914)	Never get better (n = 112)
Demographic and socioeconomic factors				
Sex: % (n)				
Men	33.1 (486)	32.5 (818)	36.3 (695)	37.5 (42)
Women	66.9 (984)	67.5 (1,701)	63.7 (1,219)	62.5 (70)
Age: Mean (SD)	39.0 (14.2)	38.3 (15.5)	39.5 (16.0)	36.8 (14.8)
Marital status: % (n)				
Single	30.1 (442)	34.4 (867)	32.8 (628)	48.2 (54)
Married/common law	58.0 (853)	53.5 (1,347)	52.3 (1,000)	31.3 (35)
Widowed	2.9 (42)	2.6 (65)	3.8 (72)	3.6 (4)
Separated/divorced	9.0 (133)	9.5 (239)	11.1 (213)	17.0 (19)
Highest educational level: % (n)				
Less than high school	15.3 (224)	22.1 (557)	28.0 (534)	31.2 (35)
High school	23.5 (345)	23.7 (596)	26.4 (503)	16.1 (18)
Post secondary education/some university	27.9 (410)	26.0 (655)	23.3 (444)	34 (30.4)
Technical school graduate	16.5 (242)	15.0 (378)	13.3 (254)	13.4 (15)
University graduate	16.8 (247)	13.1 (330)	9.0 (172)	8.9 (10)
Annual family income, CAD, % (n)				
$ 0–$20,000	24.5 (352)	32.2 (792)	35.1 (648)	45.4 (49)
$20,001–$40,000	28.3 (406)	31.3 (770)	33.3 (615)	33.3 (36)
$40,001–$60,000	26.3 (378)	19.7 (484)	18.1 (334)	11.1 (12)
Above $60,000	20.8 (299)	16.7 (411)	13.4 (248)	10.2 (11)
Pre collision health				
Health before MVC $: % (n)				
Excellent	34.0 (500)	33.1 (833)	33.6 (643)	21.6 (24)
Very good	41.0 (603)	39.2 (988)	33.1 (634)	33.3 (37)
Good	20.1 (295)	22.4 (564)	24.2 (464)	27.0 (30)
Fair or poor	4.9 (72)	5.3 (134)	9.1 (173)	18 (20)
Post collision health				
Current health: % (n)				
Excellent	7.3 (107)	1.8 (46)	1.6 (30)	0
Very good	21.2 (311)	8.9 (224)	5.7 (108)	2.7 (3)
Good	39.9 (585)	30.0 (756)	18.3 (350)	18.9 (21)
Fair or poor	31.6 (464)	59.2 (1,493)	74.4 (1,423)	78.3 (87)
Neck/shoulder pain: mean (SD)*	5.5 (2.1)	6.5 (1.9)	7.0 (2.0)	7.6 (2.0)
Headache: mean (SD)*	4.1 (3.2)	5.2 (3.3)	5.8 (3.3)	6.1 (3.4)
Low back pain: mean (SD)*	2.6 (3.0)	3.8 (3.5)	4.5 (3.6)	5.6 (3.6)
Depression score: mean (SD)†	11.1 (9.7)	16.5 (11.6)	19.5 (13.0)	23.0 (12.9)
Days from crash to self-rated global recovery: mean (95% CI)	130 (124–136)	195 (188–202)	249 (242–257)	318 (290–347)
Days from crash to resolution of neck pain: mean (95% CI)	157 (140–163)	206 (200–212)	238 (232–245)	264 (236–291)
Days from crash to resolution of pain-related limitations: mean (95% CI)	171 (164–179)	238 (230–247)	283 (275–291)	331 (301–360)

* Pain at baseline, measured on a numerical rating scale (0-10). † Post-collision depression was measured by the Center for Epidemiological Studies—Depression Scale (CES-D). SD: standard deviation; CAD: Canadian dollars; MVC: motor vehicle collision; CI: confidence interval.

ability to carry out daily home activities. After adjusting for these confounders, those who expected to get better soon experienced complete resolution of pain-related limitations 3 times as quickly; those who expected to get better slowly recovered more than twice as quickly; and those who did not know recovered almost twice as quickly as those who expected that they would never recover (Table 4).

DISCUSSION

Recovery from whiplash injuries is a prolonged process for many[21,35-44]. This underscores the importance of identifying key prognostic factors, especially those prognostic factors that are potentially modifiable and thus might serve as targets of interventions. A number of psychological factors such as coping, depression, and anxiety are important in

Table 2. Association between expectations for recovery and self-reported global recovery. Crude and adjusted hazard rate ratios (HRR) and 95% confidence intervals (CI).

Expectation at Baseline	Unadjusted HRR (95% CI)	Adjusted HRR (95% CI)*
Will never get better	1.00	1.00
Will get better soon	5.26 (3.76–7.37)	3.62 (2.55–5.13)
Will get better slowly	3.18 (2.27–4.44)	2.66 (1.88–3.75)
Don't know	2.05 (1.47–2.87)	1.95 (1.38–2.76)

* Adjusted for the following baseline confounders: post-injury depressive symptomatology (CES-D), post-injury self-reported health, post-injury neck pain intensity, and back pain intensity.

Table 3. Association between expectations for recovery and resolution of neck pain. Crude and adjusted hazard rate ratios (HRR) and 95% confidence intervals (CI).*

Expectation at Baseline	Unadjusted HRR (95% CI)	Adjusted HRR (95% CI)*
Will never get better	1.00	1.00
Will get better soon	2.62 (1.94–3.53)	1.81 (1.34–2.44)
Will get better slowly	1.74 (1.30–2.34)	1.49 (1.11–2.01)
Don't know	1.30 (0.96–1.75)	1.27 (0.94–1.71)

* Resolution of neck pain refers to a score of 0 or 1 on an 11-point numerical rating scale of neck pain intensity. Adjusted HRR are adjusted for the following baseline confounders: post-injury self-reported health, post-injury neck pain intensity, post injury headache.

Table 4. Association between expectations for recovery and resolution of pain-related limitations. Crude and adjusted hazard rate ratios (HRR) and 95% confidence intervals (CI).*

Expectation at Baseline	Unadjusted HRR (95% CI)	Adjusted HRR (95% CI)
Will never get better	1.00	1.00
Will get better soon	4.49 (3.10–6.50)	3.01 (2.05–4.43)
Will get better slowly	2.65 (1.84–3.83)	2.38 (1.62–3.48)
Don't know	1.86 (1.28–2.69)	1.93 (1.32–2.84)

* Resolution of pain-related limitations refers to a score of 0 on the Pain Disability Index. Adjusted HRR are adjusted for the following baseline confounders: percentage of body in pain after the injury, post-injury neck pain intensity, post-injury back pain intensity; post-injury headache intensity, sleep disturbance, post-injury self-rated health, post-injury depressive symptomatology, and initial self-reported limitations in daily home activities.

recovery from whiplash injuries[41-45]. Our study shows that expectation for recovery is another important prognostic factor. Self-rated global recovery took from an average of 4 months for those believing they would recover quickly to an average of almost 11 months for those believing they would never recover. Pain recovery and resolution of pain-related limitations showed a similar pattern. Regardless of demographic or socioeconomic factors, prior health, initial pain intensity, post-crash symptoms, or psychological status, those anticipating a quick recovery actually did recover most quickly. Almost one-third of the participants could not predict how quickly they would recover – interestingly, these persons actually recovered at a rate approximately midway between those anticipating a slow recovery and those anticipating that they would never recover. This pattern was observed regardless of which index of recovery was considered.

Our study confirms that there is a robust association between expectations for recovery and actual WAD recovery as assessed by several relevant types of measures. These findings have direct and important clinical interventions. Expectations for type, intensity, and duration of whiplash-associated symptoms exist prior to such an injury. Janzen, *et al*'s[12] model of health expectations posits that such expectations are not only a function of previous experiences with similar events, but of knowledge and beliefs (that may or may not be accurate) about the particular health state. WAD is seen by the general public (those who have never experienced them) as often having a poor prognosis, frequently leading to chronic symptoms[10]. It seems likely that these prior beliefs are influential in the expectations individuals form for their own recovery after an actual injury, and that these expectations for recovery are modified by the immediate injury experience (for example initial pain intensity and extent), as well as by early experiences with healthcare professionals, and the insurance and legal system.

Our findings suggest that it is worthwhile for practitioners to assess expectations for recovery as a means of identifying those injured patients at risk for poor recovery. At particular risk are those who either anticipate never getting better, or who appear unsure of what to expect. However, those who are unsure of what to expect for their own recovery may be especially amenable to interventions that address expectations.

These findings are in harmony with trials showing that early educational interventions (administered using a videotape) that include reassurance and education are beneficial for patients with WAD[45], and it is likely that this strategy works by modifying patient expectations. However, it should be noted that simply handing a patient an evidence-based information pamphlet on the positive prognosis for WAD has not been shown to be effective[46]. This may be because reassurance has to be coupled with advice about exercise (as was done in the previously mentioned videotape), or perhaps because modifying patient expectations requires a more active approach than simply providing a pamphlet. Future research is needed to identify the most effective strategy and timing for intervening in patient expectations for recovery from WAD, and to clarify the best way to deliver these interventions to those who can benefit the most (that is, those with negative expectations or those who are unsure of what to expect).

However, even if modifying persons' expectations for

recovery actually improves their outcome, the mechanism by which expectations affect recovery remains unclear. There may be several possible mechanisms, but one likely hypothesis is that changes in outcome expectations are mediated by self-efficacy beliefs, since outcome expectancy is thought to be at least partially composed of self-efficacy expectations (an expectation for successful completion of a behavioral response, nested within an overall outcome expectation)[12,18]. These self-efficacy expectations and behaviors are thought to be important mediators between behavioral responses and actual attainment of the desired outcome[47]. In turn, self-efficacy can be influenced by performance accomplishments, vicarious experience, verbal persuasion and emotional arousal[17]. What is critical is that each of these mechanisms can induce a cognitive process that provides the individual with feedback in order to evaluate and acquire new patterns of behavior to serve as stored associations for future events or consequences. This, in turn, provides necessary prior understanding for future situations that would guide subsequent expectancy formulation, enabling a cyclical and longitudinal blueprint for future situations. Interventions aimed at modifying expectancies could focus on initially uncovering what associations individuals currently have, since these associations would be unique to the situation and context; and then demonstrating how those associations may be reexamined in order to improve self-efficacy behaviors, thereby potentially altering outcomes.

Our study has several important strengths. It is a population-based inception cohort study, with complete ascertainment of all eligible WAD claimants. Although some WAD studies exclude those with other non-neck complaints, ours did not because the vast majority of persons with WAD have numerous and widespread complaints[48], and exclusion of such individuals would seriously limit the external validity of findings. Instead, we included those with other injuries and adjusted for these factors in our analysis. This makes our sample much more representative of those who make injury claims and present to health providers for care.

Also, we had extensive baseline measures so were able to consider the potential confounding effect of a wide range of demographic, socioeconomic, crash-related, and health-related factors. We had baseline measures on everyone (through the administrative claim form, which formed our baseline data). Although we experienced some attrition, our followup rate was over 80%, thus minimizing the potential effect of bias through differential attrition. Very importantly, we had several different ways of assessing recovery available to us. We believe that self-rated global recovery was the strongest measure of recovery because it does not involve an external source determining what constitutes recovery for any of our participants. However, to the researcher or clinician, it constitutes a kind of "black box" in that we do not know what considerations have gone into that self-assessment. The fact that expectations to recover are also associated with neck pain recovery and resolution of pain-related limitations in activities lends confidence to these findings. In addition, the study design respected the temporality of the exposure-outcome relationship and the dose-response relationship demonstrated in the hazard rate ratios is often used as an indication of causality.

Our study also has several limitations. Outcome information was ascertained at pre-specified timepoints rather than assessed on a continuous basis. This means that we cannot identify the precise time at which these indices of recovery were reached. Much more frequent assessment of outcome would lead to richer and more precise information about time to recover; it would also incur an unreasonable burden on participants, and would be impractically costly in such a large study. It is likely that the effect of this bias would be to artificially decrease the effect size, and that our estimates are a conservative measure of the true association.

We chose the conservative outcome of "0" or "1" for neck pain recovery and of "0" for recovery in pain-related limitations in activities. It should be recognized that these endpoints may not reflect pre-crash health, since non-WAD related neck pain is common in the general public and working population[49]. An ideal alternative would have been to compare neck pain and pain-related activity limitations at followup with actual pre-crash values, although it is seldom possible to get this information. It is common to use self-report after the crash to ascertain information about pre-crash pain conditions; however, these data may be systematically biased in favor of exaggerated estimates of prior health and minimization of prior pain problems[50]. However, it is unclear how much bias there might be in jurisdictions with no-fault insurance systems.

One way of addressing this issue indirectly is to assess the similarities and differences between this cohort of WAD claimants and the general, non-injured population. Several years ago, we studied the health of a random sample of the general adult population in the same province, and can draw some comparisons[51-53]. In the current cohort of WAD claimants, almost 64% of participants reported having had very good or excellent pre-crash general health. In the earlier random sample survey, only 54% of the sample reported having very good or excellent health. Although this might suggest overreporting of positive health status by WAD claimants, another possible explanation is the younger age of the participants in the WAD cohort. One-third of the sample in the earlier health survey study was aged 50 or older, whereas only one-quarter of the WAD claimants was in that age range. We would expect better overall health in younger individuals. On average, we would also expect better health in those driving vehicles than in the general population.

As well, there is good evidence that a past history of WAD is a risk factor for prevalent neck pain and other health complaints[37,54,55]. In examining the self-reported health of

that subgroup of persons in the earlier general population sample who reported no history of neck injuries (who might be considered similar to WAD claimants prior to the crash), almost 60% (similar to our study) report having very good or excellent general health. This suggests less bias in these measures than might have been expected. Other demographic differences in the 2 cohorts (data not shown) was a higher educational attainment in the WAD group than in the general population sample (which might be related to the younger age of the participants); a preponderance of women in the WAD cohort; and, despite the higher educational attainment, lower income (which may be a result of the higher proportion of women in this group, who had lower income).

Expectations for recovery, measured in the first 6 weeks after a traffic-related WAD, predict actual recovery, as assessed using a global self-assessed recovery question, a pain intensity questionnaire and a questionnaire measuring pain-related limitations in daily activities. These findings were robust after adjusting for a large number of demographic, socioeconomic factors, health, crash-related factors, and post-crash symptoms and pain.

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