

## Measures of Spontaneous and Movement-Evoked Pain Are Associated With Disability in Patients With Whiplash Injuries

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**Abstract:** This study examined the degree to which measures of spontaneous and movement-evoked pain accounted for shared or unique variance in functional disability associated with whiplash injury. The study also addressed the role of fear of movement as a mediator or moderator of the relation between different indices of pain and functional disability. Measures of spontaneous pain, single-point movement-evoked pain, repetition-induced summation of activity-related pain (RISP), and fear of movement and disability were obtained on a sample of 142 individuals who had sustained whiplash injuries. Participants' pain ratings, provided after lifting a weighted canister, were used as the index of single-point movement-evoked pain. RISP was computed as the increase in pain reported by participants over successive lifts of 18 weighted canisters. Measures of functional disability included physical lift tolerance and self-reported disability. Hierarchical regression analyses revealed that measures of single-point movement-evoked pain and RISP accounted for significant unique variance in self-reported disability, beyond the variance accounted for by the measure of spontaneous pain. Only RISP accounted for significant unique variance in lift tolerance. The results suggest that measures of movement-evoked pain represent a disability-relevant dimension of pain that is not captured by measures of spontaneous pain. The clinical and conceptual implications of the findings are discussed.

**Perspective:** This study examined the degree to which measures of spontaneous and movement-evoked pain accounted for shared or unique variance in functional disability associated with whiplash injury. The findings suggest that approaches to the clinical evaluation of pain would benefit from the inclusion of measures of movement-evoked pain.

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**Key words:** Whiplash, pain, evoked pain, movement, fear, disability.

Whiplash injuries result from head and neck exposure to abrupt changes in velocity, most commonly caused by motor vehicle accidents.<sup>3,4</sup> Whiplash accounts for approximately 80% of the soft tissue injuries incurred in motor vehicle accidents.<sup>11</sup> The recovery trajectory following whiplash injury can be quite prolonged, with as many as 50% of individuals reporting symptoms of neck pain 1 year after

injury.<sup>11,19</sup> Approximately 15 to 25% of individuals who sustain whiplash injuries will remain permanently disabled.<sup>7,17,34,39</sup>

Pain severity has been identified as a significant determinant of whiplash-related disability.<sup>19</sup> Although findings have been mixed, several studies have reported that more severe pain following injury is associated with more severe disability.<sup>5,10,19,20,33</sup> However, the relation between pain severity and disability has been weaker than expected. Even in studies where pain severity has emerged as a significant predictor of disability, the variance in disability accounted for by pain severity has been modest, rarely exceeding 10%.<sup>26</sup>

Studies that have examined the relation between pain severity and disability in individuals with whiplash injuries have relied almost exclusively on measures of spontaneous pain.<sup>26</sup> On measures of spontaneous pain, respondents are asked to rate the severity of the pain

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associated with their pain condition. Such measures are typically completed while the respondent is in a sedentary position. Because disability entails limitations of activity participation, measuring pain in the absence of activity demands may not provide the best index of disability-relevant pain. Measures of pain elicited by activity might have greater value as predictors of disability than measures of spontaneous pain.

In the present study, we examined whether measures of movement-evoked pain might account for unique variance in measures of disability beyond the variance accounted for by measures of spontaneous pain. Two measures of movement-evoked pain were used. We used a single-point measure of movement-evoked pain in which patients were asked to rate their pain as they lifted a 2.9-kg weighted canister. We also used a measure of repetition-induced summation of activity-related pain (RISP), in which we computed the change in pain ratings as patients lifted a series of 18 weighted canisters.

In spite of a wide range of treatment approaches that have been used to date, whiplash injuries continue to contribute to alarmingly high rates of persistent pain and disability. Studying the dimensions of pain experience that contribute to disability has both clinical and theoretical implications. From a clinical perspective, findings showing that measures of movement-evoked pain contribute unique variance to whiplash-related disability might lead to the development of more comprehensive clinical assessments of pain associated with whiplash injury.<sup>46</sup> In turn, increased knowledge of the determinants of disability in individuals with whiplash injuries might point to new avenues of intervention.<sup>53</sup> From a theoretical perspective, findings concerning the differential association between different measures of pain and measures of disability might bring greater precision to conceptual models addressing the role of pain on motor function in individuals who have sustained whiplash injuries.<sup>14,18,28,29</sup>

In the present study, individuals with whiplash injuries participated in a testing session during which measures of spontaneous pain, single point movement-evoked pain, and RISP were collected. Participants also completed subjective and objective measures of disability. Regression analyses were used to assess the shared and unique variance in measures of disability accounted for by the 3 measures of pain. Secondary analyses addressed whether fear of movement mediated or moderated the relation between measures of pain and disability.

## Methods

### Participants

The study sample consisted of 142 participants (68 women, 74 men) who had sustained whiplash injuries in rear-collision motor vehicle accidents. Potential participants were recruited through advertisements posted in rehabilitation clinics and newspapers in Montreal, Quebec. Individuals were considered for participation if 1) they had sustained a whiplash injury in a rear-collision accident within the previous 24 months, 2)

they had received salary indemnity from a motor vehicle insurer for whiplash-related limitations, and 3) there were no medical contraindications to participation in the lifting tasks used in the study. The mean age of the sample was 40.4 years with a range of 20 to 60 years. The mean time since injury was 8.4 months with a range of 1 to 24 months. The majority of the sample were married or living common-law (93%), had completed high school (95%), and were work-disabled (74%). Participants provided informed consent.

## Measures

### Spontaneous Pain

The McGill Pain Questionnaire (MPQ) was used as the measure of spontaneous pain associated with participants' whiplash injury.<sup>25</sup> On this measure, participants are asked to endorse the adjectives that best describe their pain experience. The MPQ Pain-Rating Index (PRI) was computed as the weighted sum of all adjectives endorsed. The MPQ-PRI has been demonstrated to be a reliable and valid measure of chronic pain experience.<sup>48</sup>

### Single-Point Movement-Evoked Pain

Participants were asked to rate their pain on an 11-point (0–10) numerical rating scale as they lifted a 2.9-kg canister. This measure represents the pain evoked by a physical task performed at one point in time.

### RISP

The RISP score was derived by subtracting the mean pain ratings provided for the first 3 lifts from the mean pain ratings provided for the last 3 lifts in the series of 18 canisters. Higher values reflect greater increase in pain across successive lifts.

### Lift Tolerance

Following completion of the canister-lifting task used to derive the index of RISP, participants were asked to lift a 3.9-kg canister with arm fully extended and hold for as long as possible. Lift tolerance was used as an index of functional disability. Previous research has shown that lift tolerance is significantly associated with measures of self-reported disability. Lift tolerance is often included as part of functional evaluation assessments.<sup>21,32</sup>

### Self-Reported Disability

The Pain Disability Index (PDI) was used as a self-report measure of pain-related disability. On this measure, participants rate their level of disability in 7 different domains of daily living (home, social, recreational, occupational, sexual, self-care, and life support). For each life domain, participants are asked to provide disability ratings on 11-point scales with the endpoints 0 (no disability) and 10 (total disability). Responses were summed to yield an overall index of self-reported functional disability. The PDI has demonstrated good internal consistency and correlates significantly with objective measures of disability.<sup>45</sup>

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