University of Alberta

# Pain-Related Depression, Anxiety, Anger, Frustration and Fear in Whiplash-Associated Disorders: How Do People Feel Six Weeks After Their Injury?

by

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## Abstract

The purpose of this thesis is to describe the emotional states (anxiety, anger, frustration, fearfulness and depression) related to pain at six weeks after whiplash injury and to investigate the predictors that predict these emotions.

This thesis is composed of two separate studies. The population included all Saskatchewan residents, who submitted a claim to Saskatchewan Government Insurance for a traffic injury.

Descriptive, logistic and multiple linear regressions were used for data analysis. Results showed the two pain-related emotions rated with the highest intensity were frustration and anger. Patients' education combined family income, prior emotional status, lawyer involvement, ringing in ears and initial pain intensity were important predictive factors.

In conclusion, pain-related frustration and anger were rated as more intense than depression and anxiety six weeks after a traffic injury, and we report the associations between demographic characteristics, collision-related symptoms and initial pain intensity, and the pain-related emotions.

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# Chapter One Introduction

## 1.1 Whiplash Injuries

### 1.1.1 Whiplash-Associated Disorders (WAD)

Worldwide, traffic collisions kill 1.2 million people and another 50 million people are injured every year (World Health Organization 2004). Although traffic injuries are currently ranked at the ninth spot for global diseases of burden, it is projected they will rise to the number three spot by 2020 (WHO). Whiplash-associated disorders (WAD) are the most common and troublesome health problem in industrialized countries (Cassidy et al., 2000; Côté et al., 1998; Picavet and Schouten, 2003) and have become an international medicolegal and social dilemma (Ferrari and Russell, 1999). Not only do they create an ever-increasing financial burden on insurers, they also place an important burden on patients and the healthcare system (Spitzer et al., 1995).

The incidence of WAD has been reported from between 13 per 100,000 inhabitants in New Zealand (Mills and Horne, 1986) to a staggering 1,168 per 100,000 inhabitants in British Columbia, Canada (Allen, 2002). A history of exposure to motor vehicle crashes with sequelae of neck pain has been shown to have a substantial impact on future persistent neck pain and associated disability (Berglund et al., 2000; Bunketorp et al, 2005). A significant proportion of individuals with chronic neck pain in the general population reported that they had injured their necks in a motor vehicle collision (Côté et al, 2000).

According to the Quebec Task Force on Whiplash-Associated Disorders, whiplash is defined as an acceleration-deceleration mechanism of energy transfers to the neck and may result from motor vehicle collisions (Spitzer et al., 1995).

Depending on whether the impact is from the rear, the front or the side of the struck vehicle, the mechanism of injury involves a sudden and forceful flexion, extension or sideways movement of the neck, followed by several less violent oscillations of the neck and alternating flexion and extension (or side movements). Although some believe that this acceleration/deceleration mechanism results in a mechanical trauma of the supporting ligaments and muscles of the cervical spine, the precise pathological changes are unclear. In fact, it is unclear whether symptoms that occur subsequent to the whiplash exposure are always (or even usually) a result of pathological changes in the neck. Interestingly, experimental work has suggested that some individuals report neck pain after exposure to a sham collision (Castro et al., 2001).

The cluster of symptoms reported by individuals exposed to the acceleration/deceleration mechanism has been coined whiplash associated disorders (WAD; Spitzer et al., 1995). It has been suggested that WAD is a complex condition involving disturbances in motor function, nociceptive processing and psychological distress (Curatolo et al., 2001, Moog et al., 2002, Nederhand et al., 2002 and Sterling et al., 2002).

The severity of WAD varies from case to case, and the seriousness of the injury is dependent on the variety of complacating conditions. The most immediate and apparent symptom is neck pain. Headache, a common complaint, is often both persistent and predominant. In addition, WAD patients often complain about a variety of other symptoms such as shoulder or arm pain, jaw pain, fatigue, insomnia, dizziness or vertigo, tinnitus (ringing in ears), and memory and concentration problems (Spitzer et al., 1995; Radanov et al., 1995; Mayou and Radanov, 1996). Although it has been reported that the vast majority of people recover from WAD within a few weeks or months (Spitzer et al., 1995), it has been reported that a large number of individuals (12%-40%) experience continuing symptoms (Borchgrevink et al., 1996; Radanov et al., 1996).

### 1.1.2 Psychological symptoms of WAD

Besides the physical symptoms mentioned above, people with whiplash injuries report experiencing at least short-term psychological symptoms (Ferrari et al., 2005; Carroll et al., 2006). Several studies have described the psychological features of WAD. For example, it has been reported that WAD sequelae include acute stress disorder (ASD), post-traumatic stress disorder (PTSD), depression and anxiety, all of which typically occur after extremely stressful events (Adshead, 2000; Silove et al., 2003; Vaiva et al., 2003). Jasper (1998) has reported that 25% of those with traffic injuries experienced ASD symptoms within several days of the injury; 18.4% were still experiencing PTSD symptoms six months after the event. Sterling found that all those experiencing whiplash injury displayed initial psychological distress (Sterling 2003). Also, acute, moderately severe emotional distress was found to be common in another study (Mayou 1993). Some articles concluded that motor vehicle injuries could result in considerable psychological morbidity that is not closely related to the severity of the medical problems (Mayou1994; Blanchard 1995; Taylor 1995).

### 1.1.3 Redefinition of Whiplash

Because of the importance of psychological and social aspects of whiplash, it has been proposed that WAD should not be viewed a specific, anatomically definable injury. Rather, it should be seen as a "general illness" with symptoms that arise from and are modulated by pathology, psychological responses, and social context (Ferrari et al., 2005). Accordingly, it has been said that the "culture" may contribute to the outcomes of WAD (Ferrari et al., 2005).

### 1.1.4 Biopsychosocial model of health for WAD

Pain is a multidimensional subjective experience mediated by the person's beliefs, emotions, coping styles, and a variety of other perceptual influences. Although WAD patients reported a variety of chronic symptoms, there was no evidence that acute injury leads to actual physiological damage in the neck or back, causing chronic pain (Ferrari and Russell, 1997). Therefore, it appears that responses to pain and pain treatments reflect complex biopsychosocial interactions between genetic, developmental, cultural, environmental and psychological factors (Turk and Holzman, 1986).

The biopsychosocial model of health would help to explain the diverse nature of WAD (Ferrari et al., 2005). This model is a broad systems perspective involving pain, attitudes and beliefs, psychological distress, illness behaviour and social environment. Psychological distress may modify the whole pain process (Waddell, 1998). Biological factors may initiate and maintain physical perturbations; psychological factors may influence the appraisal and perception of pain; and social factors may shape the behavioural responses of patients to the perceptions of their pain (Gatchel, 1996).

According to Price and Wade's sequential model of pain processing (Price, 1999; Wade et al, 1992 and 1996), the initial stage is the perceived intensity of the pain sensation. According to this model, the second stage is immediate unpleasantness which is often linked to the physical pain sensation. The third stage involves longer-term reflective or cognitive processes that relate to the meaning or implications that pain holds for one's life. Thus, negative emotions (depression, anxiety, anger, frustration and fearfulness), as well as expectations, beliefs and meanings characterize how pain is processed, and these negative emotions are closely related to "suffering". The fourth and final stage is that of overt behavioural expression of pain. The biopsychosocial model of pain provides a guideline for multidisciplinary interventions aimed at treating people affected by WAD.

## 1.2 Emotions

### 1.2.1 What are emotions?

Emotion is a specific psychological state. It is central to our psychology and is an important and challenging issue for research (Kalat and Shiota, 2007). Although there is no clear, consistent definition for emotion, some researchers have suggested definitions that seem useful.. For example, Keltner and Shiota (2003) have suggested that emotions are universal, functional reactions to external stimulus events, which temporarily integrate physiological, cognitive, phenomenological and behavioral channels to facilitate response to the situation the individual finds himself or herself in. Discrete emotions are also said to have distinctive feelings, thoughts, behaviors and emotivational goals (Roseman et al., 1994).

### 1.2.2 Basic Emotions

The question: "Are there basic emotions?" is a controversial one. According to Gerrod Parrot (2001), emotions can be hierarchically categorized as six basic-emotion clusters and 25 subclusters. Firstly, the 135 identified emotions were grouped as 25 subclusters according to their similarity. Meanwhile 25 emotion names were developed to describe these 25 clusters. Secondly, these 25 subclusters were further divided into six diverse clusters which Parrot considered basic. Similarly six emotion names were chosen to represent the aggregate emotions. These six emotions were: Love, Joy, Surprise, Anger, Sadness and Fear.

Consequently, each cluster of emotion has its own subclusters. (1) Love has three subclusters: Affection Lust and Longing. (2) Joy has seven subclusters: Cheerfulness, Zest, Contentment, Pride, Optimism, Enthrallment and Relief. (3) Surprise represents the third cluster, while the cluster (4) "anger" has six subclusters: Irritation, Exasperation, Rage, Disgust, Envy and Torment. (5) Sadness has six: Suffering, Sadness, Disappointment, Shame, Neglect and Sympathy, while the subclusters of (6) Fear are Horror and Nervousness.

Five emotions are relevant to this study. Depression, anxiety, anger, frustration and fear could be conceptualized as belonging to three distinct clusters of basic emotions (Parrot, 2001). In his 'short tree' structure of emotions, depression is in the subcluster of Sadness which belongs to the larger cluster of the same name (Sadness). Frustration and anger are in two subclusters of "Exasperation" and "Rage" respectively, and these subclusters both belong to the overall cluster of "Anger." The subclusters for fear and anxiety are "Horror" and "Nervousness, which are included in the cluster of "Fear" (Parrott 2001).

### 1.2.3 Depression

Depression is an emotional response that involves persistently low spirit, hopelessness and loss of interest. It can cause a variety of physical symptoms such as changes in appetite, sleep, body movement, thought and concentration. A depressed person may have severe feelings of worthlessness, guilt and suicidal tendencies (Robertson and Katona, 1997). Depression has been considered one of the most common and debilitating of the major psychological disorders and is viewed as a complex biopsychosocial phenomenon (Ross et al, 1997). The American Psychiatric Association has defined "Major depression" as a loss of pleasure, interest, and productive activity lasting most of each day for at least two weeks, severe enough to interfere with life. It is recognizable by five of eight features (DSM-IV; American Psychiatric Association, 1994):

- depressed mood of at least two weeks' duration,
- loss of pleasure in most activities
- significant weight change
- disturbed sleep,
- loss of energy
- feelings of worthlessness or guilt
- trouble concentrating or making decisions

- thoughts of death

### 1.2.4 Anxiety and Fear

Anxiety is an emotional reaction characterized by ambiguity, fear and worry, which often develops after some encounter with an internal or external threat (Spielberger et al., 1983). It refers to a general expectation that "something bad might happen," without identifying a particular danger (Lazarus, 1991). According to DSM-IV; American Psychiatric Association 1994, the diagnostic features of Generalized Anxiety Disorder (GAD) are:

- The person feels excessive anxiety and worry about a number if events or activities occurring more days than not for at least six months
- The person is unable to control worrying thoughts.
- The psychological symptoms of anxiety are associated with three or more of the following symptoms: restlessness; being easily fatigued; difficulty concentrating; irritability; muscle tension; sleep disturbance.
- The focus of the anxiety and worry is not confined to features of an Axis I disorder.
- The anxiety, worry and/or physical symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.
- The disturbance is not due to the direct physiological effects of a substance.

Fear is an emotion experienced in anticipation of some specific pain or danger (Kalat and Shiota, 2007; Hafen et al., 1996). Fear and anxiety are similar experiences, characterized by feeling of danger and a sense of being threatened. The difference exists in what kinds of experiences trigger these responses. Fear is a response to a specific perceived danger, while anxiety is a result to an unidentified situation (Kalat and Shiota, 2007).

### 1.2.5 Anger and Frustration

The term "anger" refers to a strong passion or emotion of displeasure, excited by a real or supposed injury or insult to oneself or to others (Hafen et al., 1996). Anger is viewed as having two defining features: cognitive appraisal and action tendency. Ortony et al. (1988) proposed that anger is a compound emotion combining attributions about the action of an agent with one's own well-being; more specifically, anger is related to disapproving of someone else's blameworthy action and being displeased about the related undesirable event. Anger is characterized by physiological arousal, characteristic facial expressions and impulses towards aggression (Smith, 1994); it is typically conceived of as a transitory state that occurs in response to perceived unfair treatment or harm (Berkowitz, 1990). An angry emotional reaction can be adaptive, particularly when expressed in a constructive fashion, but chronically angry emotional reactions are often maladaptive because they lead to pervasive interpersonal disruption and chronic sympathetic activation (Greenwood et al., 2003).

Frustration is commonly defined as the feeling that one has not achieved a desired goal (Abler et al., 2005). Attaining a desired objective is a satisfying experience for nearly everyone. But most people are familiar with the feelings that accompany failure. One such feeling is frustration, the emotional reaction that occurs when when people miss a rewarding event or item. People sometimes use anger widely to comprise frustration and considered that frustration is a mild form of anger. However, frustration becomes anger only when it becomes agent-focused, regardless of when in the sequence that happens (Clore and Centerbar, 2004).

### 1.2.6 Fear and anger

In Boring's theory of emotion, fear differs from anger in that it is characterized by an attempt to withdraw from the scene or avoid the fearful situation. The energy in a fear-inducing emergency is normally used for escape, not for attack. Fear and anger are often mixed. Obvious fear may mask anger or vice versa. This mixture may often occur when anxiety is involved. If fear and anger do not blend, fear is a retreat in the face of frustration and anger. Take a man as an example: when men are afraid of something, the frustrated man wants to run away, while the angry man wants to attack. In a sense, one is responding defensively, while the other is responding via an offensive reaction (Boring, 1945).

### 1.2.7 Distinguishing emotions

Discrete emotions can be distinguished by the feelings, thoughts, actions, tendencies, and motivational goals associated with that emotion (Roseman et al., 1994). When we are fearful, we feel our hearts pumping and think about how bad things could get. We may feel like running away and want only to get to a safe place. Frustration involves an obstacle that was in our way; we may feel that we are being blocked and want to lash out and kick; we want to get past something and overcome some obstacle. Anger has the feeling blood rushing through the body, the sense that one might explore; we may think about doing violence toward others and also about how unfair something was; we may feel like hitting someone, yelling, saying something nasty and wanting to hurt somebody.

### 1.2.8 The Experience of Emotion.

It has been proposed by Boring that individual emotions can evolve into other emotions and that emotions can interact with each other (Boring, 1945). In his classic discussion of emotional states, he theorized that frustration can lead to anger and fear, whereas anger leads to depression and anxiety. When people are angry, they feel that their freedom of thought or of action is threatened. When they dare not attack whatever is engendering the anger, and eventually give up their efforts, they are likely to experience the depression of failure and anxiety. Boring formulated that frustration may make fear flourish. When danger is proximate, fear develops and is sustained, especially when nothing can reduce the threat. Sometimes fear is an unpleasant emotion which begins as depression and ends in excitement, though it may begin in a sudden shock. "Anxiety is a depression or apprehensiveness not as intense as fear and it is a symptom of frustration or mental conflict." According to Boring (1945), fear is a state of depressed, fatigued, apprehensive worry, and frustration will "always" be the outcome. Anxiety is a fear arising from a contradiction of emotions (McGill and Welch, 1946). In Tavris' theory (Tavris, 1989) about anger, anger and depression can be experienced and displayed independently or simultaneously. First, depression may be the consequence of anger. When anger is unsuccessful in averting danger or removing obstacles, apathy may eventually develop. However, anger and depression may be distinct, learned reactions to prolonged stress, depending on a person's social history and possibly also on genetic differences in hormone metabolism. Most commonly though, anger and depression occur simultaneously (Tavris, 1989).

# Chapter Two Background

## 2.1The importance of psychosocial factors in the development of WAD

Recent evidence suggests that psychological distress is a common feature of whiplash-associated disorders (WAD), although studies investigating psychological factors in WAD are relatively sparse when compared to studies exploring other musculoskeletal conditions. The literature reports that psychosocial factors play an important role in the prognosis of WAD and this importance is increasingly being recognized. This is an important issue since it has been demonstrated that whiplash-associated disorders account for a large proportion of the overall impairment and disability caused by traffic injuries (Sterner and Gerdle, 2004; Sullivan et al., 2002). Recent studies have shown psychological distress was the greatest predictor of persistent neck pain following a motor vehicle collision (Atherton et al, 2006; Jensen et al., 2004; Guez, 2006). Psychological distress is also claimed to be associated with pain coping strategies and to play a role in recovery from whiplash injury (Sterling, 2005; Carroll et al., 2006b). In the long term, psychological morbidities were found to persist five years after the motor vehicle accident; these were associated with adverse effects in everyday activities (Mayou et al., 1997). Hart et al found the relationship between psychological distress and cognitive impairment especially significant for pain-related negative emotions and also for variables that mediate suffering such as interference with activities and increased somatic vigilance. This relationship was independent of the effects of pain intensity (Hart et al., 2003).

## 2.2 Emotions

Emotions are an important aspect of psychological distress. They promote a state of preparedness for activity, and, physiologically, are associated with changes

in the autonomic nervous system. It has been proposed that the inhibition of certain emotions may damage individuals' physical well-being. Specially, the blocking of anger and other forms of emotional distress coinciding with chronic stress/pain can deactivate the production of endogenous opioids and natural killer cells; this in turn reduces the body's defense against disease, pain and depression (Beutler et al., 1986). It is generally accepted that negative emotional factors also play an important role in the perception and experience of pain (Gatchel and Turk, 1999). Furthermore, there is good evidence to suggest that along with the pain itself, such negative emotional responses contribute towards other aspects of chronicity, such as increased disability (Robinson and Riley, 1999).

### 2.2.1 Depression and anxiety

Depression has been seen as a public health problem with high prevalence and related health care utilization, disability, and suicide attempts (Broadhead et al., 1990; Johnson et al., 1992; Leon et al., 2002; Conner et al., 2001). In one study, more than 20% of the general population was found to be suffering from clinical or subclinical depression (Carroll et al., 2000). In chronic pain patients or those with severe pain, about 40% to 60% experienced some form of depression (Romano and Turner, 1985; Carroll et al., 2000). Also, in the term of gender difference, it was demonstrated that more women than men were troubled by this psychological disorder (Nolen-Hoeksema, 2001; Piccinelli, 2000).

There is evidence that after a traffic injury, many patients had moderate to severe psychological problems: guilt, depression, anxiety and a distorted self-image, which interfered with their quality of life (Holbrook et al., 1998; Michaels et al., 1999). Therefore, we may say whiplash injury sufferers are anxious and depressed as are most patients with chronic pain; those with the longest history of pain were most depressed (Lee et al., 1993). It was also revealed that pre-injury depression or anxiety symptoms were significantly associated with poor outcome on both physical and psychological outcome scales (Lankester et al., 2006). Carroll et al. found

depressive symptomatology was an effect modifier of the relationship between early use of passive coping strategies and slower recovery after whiplash injury (Carroll et al., 2006b). In addition, depressive symptomatology after whiplash was found to be common: 42.3% of subjects who reported having had no mental health problems prior to their injury, developed depressive symptoms within six weeks after the event (Carroll et al., 2006a). Mayou et al (2001) found evidence that 39% of patients still suffered from depression a year after injury. Depression was also found to relate to disability, even after controlling for pain intensity (Holzberg et al., 1996).

Sullivan et al. (2002) observed that only anxiety and depression, rather than pain severity and pain-related disability, contributed significant unique variance to the prediction of perceived cognitive deficits in whiplash injury. In a recent large cross-sectional study, subjects who reported a whiplash injury that had occurred more than two years ago were more likely (than those without such an injury) to experience anxiety and depressive disorders (two years later) (Wenzel et al., 2002). However, in those reporting more recent whiplash injuries, there was no such association with anxiety and depression. These findings suggest that symptom persistence is the trigger for psychological distress (Wenzel et al., 2002). A study of 188 patients who were interviewed 10 days after being involved in a traffic collision found that 41% suffered severe anxiety; anxiety was the most common psychiatric symptom at 3 months and one year later (Mayou et al., 1993). Similarly, in Mayou's 2001 study, 52% patients exhibited symptoms of general anxiety a year after being involved in a crash..

In pain literature, depression and anxiety receive the majority of attention, and there is considerable research to suggest that anxiety and depression are associated with increased pain sensitivity and pain-related disability (Banks and Kerns, 1996; Vlaeyen and Linton, 2000). One clinical study found that anxiety was more strongly associated with the pain experience in men than in women exposed to whiplash trauma from clinical-based study (Elklit et al., 2006).

### 2.2.2 Frustration and anger

Although only a limited amount of research has considered anger in persons with musculoskeletal conditions, there is a small body of literature on this topic. Anger has been reported to be a common affective emotional state in patients in chronic pain (Fernandez and Turk, 1995; Greenwood et al., 2003). The negative feeling of anger was strongly related to measures of pain intensity, reported frequency of pain behaviors, and perceived interference with activities of daily living (Kerns et al., 1994).

Anger might be the direct effect from pain and unpleasant outcomes (Berkowitz and Harmon-Jones, 2004; Ortony et al., 1988). In turn, the neck pain was found to be especially common in those with chronic anger (Hafen et al., 1996). It has been proposed that anger may have greater influence on chronic pain severity than other negative emotions, probably because of increasing muscle tension near the site of injury (Burns, 2006).

Anger may be as (or more) powerful a determinant of enlarged pain sensitivity as depression and anxiety. This is suggested by growing empirical literature (Fernandez and Turk, 1995). Anger is considered an important emotion because it can exacerbate pain. Theories of pain such as the gate control theory and the neuromatrix theory maintain that intense negative emotions such as anger can increase pain by altering descending and central pain modulation systems (Melzack, 1991)). In some studies, anger was significantly related to pain, with patients reporting the highest level of anger also experiencing the most severe pain (Greenwood et al., 2003; Bruehl et al., 2002). The emotion of frustration receives far less attention in the literature concerning pain and whiplash injury. One cross-sectional study found that frustration, rather than anxiety or depression, was the predominant emotion in those with acute back pain (Philips and Grant, 1991). Both anger and frustration appear to be critical concomitants of the pain experience (Wade et al., 1990).

### 2.2.3 Depression and anger

There has been a long-standing notion in psychodynamic theory that depression is anger turned inwards (Gershon et al., 1968; Friedman, 1970). Wade et al. (1990) applied multiple regression analyses to discern the predictability of depression from anger. They found VAS measures of anger significantly predicted scores on the Beck Depression Inventory (BDI) and depression scale of the MMPI. Tschannen et al. (1992) used path analyses to determine that inhibited anger was a predictor of depression.

### 2.2.4 Fear

While published studies investigating the association between fear and pain are plentiful, those focused on fear and whiplash injury are scarce. Pain-related fear was found to be an important factor influencing daily activities and determining the further course and maintenance of the inability to work in individuals suffering low back pain" (Swinkels-Meewisse et al., 2006; Gheldof et al., 2005). Findings have also suggested that pain-related fear and avoidance were essential features in the development of a chronic musculoskeletal pain (Vlaeyen and Linton, 2000). In that study, high fear of movement/(re)injury corresponded to low self-efficacy. In another study, self-efficacy was the most important predictor of persistent disability, contributing to 42% of the variation in the PDI (Pain Disability Index) score (Bunketorp et al., 2006). In whiplash injury, fear may lead to amplification of whiplash symptoms. Fear about the crash event, the outcome and fear engendered by the responses from health care professionals may amplify the whiplash symptoms.

It has been demonstrated that individuals with an initial fear of long-lasting symptoms and disability have symptoms for a longer duration than those who do not expect such chronic problems and who worry less about these possibilities (Radanov et al., 1995). It has also been observed that pain-related fear is significantly

associated with reduced lumbar flexion among persons with chronic musculoskeletal low-back pain (Geisser et al., 2004).

Many of those with WAD suffer from phobic avoidance of traveling in motor vehicles, rather than from posttraumatic stress disorder (PTSD) (Hickling & Blanchard, 1992; Kuch et al., 1985; Mayou et al., 2001).There is some evidence to suggest that individuals with prior emotional problems are more likely to suffer from phobic travel anxiety (Mayou et al., 2001). It has been suggested that the association between fear of movement and lower muscle activity level is associated with high pain intensity in whiplash patients (Nederhand et al., 2006). In another study, high levels of fear of movement/(re)injury were found to correspond with low self-efficacy in patients affected by subacute whiplash-associated disorders (Bunketorp et al., 2006).

Among the studies of "fear," the term of "fear of movement / (re)injury" or "kinesiophobia" has received considerable attention in the recent literature of whiplash. The other related types of fears found in the literature are: fear-avoidance, fear of death, fear of pain, fear of long term disability, and fear of traveling in a car. There are only a few studies investigating fear as a psychological state in pain or in whiplash patients. In our study, we will investigate pain-related fear as a general emotional state after traffic injury.

# Chapter 3 Introduction to the Current Project

Whiplash-associated disorders (WAD) are among the most common and troublesome health problem in industrialized countries (Côté et al., 1998; Picavet and Schouten, 2003). Not only do they create an ever-increasing financial burden on insurers, but they also represent an important burden on patients and the healthcare system (Spitzer et al., 1995).

In addition to their physical symptoms, individuals with whiplash injuries experience at least short-term psychological symptoms (Ferrari et al., 2005; Carroll et al., 2006). Some studies conclude that motor vehicle injury can result in considerable psychological morbidity which is not closely related to the severity of the person's medical problems (Mayou1994; Blanchard 1995; Taylor 1995). The diverse nature of WAD may be explained by the biopsychosocial model of health (Ferrari et al., 2005). It is essential to assess the emotional status of people after they are injured in a traffic collision and to determine the predictive factors associated with these emotions. We believe that our findings will have implications for clinical assessment and treatment.

This thesis is composed of two separate but interrelated studies. Both involve the same study population: Saskatchewan residents, 18 years of age or older, who submitted a claim to Saskatchewan Government Insurance (SGI) for a traffic injury that occurred between July 1, 1994, and December 31, 1995. We used descriptive analysis and multiple linear regression analyses to describer pain-related emotions at six weeks and to determine the factors that predict the intensity of these emotions.

Firstly, we describe the pain-related emotions experienced by individuals six weeks after a traffic-related whiplash injury. These emotions included pain-related anxiety, anger, frustration, fearfulness and depression. We evaluated patient responses to determine the intensity of each of these emotions at six weeks post-whiplash injury, and to describe the characteristics of persons experiencing these emotions.

Secondly, we examine four domains of potential explanatory factors. We determined which baseline factors (early post-injury) were predictors of intensity of the above pain-related emotions at six weeks post-whiplash injury. Multiple linear regression analyses were employed for this data analysis.

Each question investigates important questions regarding whiplash patients. For example: what is the emotional status of whiplash patients at six weeks after traffic injury? Are pain-related depression and anxiety the most important psychological distresses? What are the predictive factors associated with pain-related emotions six weeks after injury? More importantly, the anwers to these questions may serve as a guide to those who might benefit from early evaluation of their psychological state. Our findings could also shed light on why some people experience a prolonged or complex course of recovery from a whiplash-associated disorder.

# Chapter 4 Materials and Methods

## 4.1 Study Population

Saskatchewan Governmental Insurance (SGI) is the only provider of motor vehicle insurance in Saskatchewan. The current study includes a subcohort of participants of a larger study, carried out by Cassidy and Carroll. At the time of that study, the province was home to approximately 736,000 people aged 18 years or older. The current data are from a population-based study of traffic injury claims (Cassidy et al, 2000). That study population included all Saskatchewan residents, 18 years of age or older, who submitted a claim to Saskatchewan Government Insurance for a traffic injury that occurred between July 1, 1994, and December 31, 1995. There was a total of 10,902 eligible opened claims during the 18-month study period. Excluded were: 292 fatalities; 113 workers' compensation claims, and the claims of 81 non-English speaking residents, 86 individuals who had more than one injury claim during this study period; 69 seriously-injured claimants, and 38 individuals who could not answer the questionnaire due to serious unassociated illnesses. Another 1,010 claimants were excluded because they did not complete their claims forms (that is, they decided to drop their initial claims). Also excluded were another 207 claimants who followed their lawyers' suggestion and did not complete their claim forms fully. Among the remaining 9,006 claims, 525 individuals were excluded from our sample because of hospitalization lasting longer than two days (which suggests a more serious injury than WAD), and; 357 non-automotive claims. Of the remaining 8,124 claimants, 7,462 met the case definition for neck injury, and their data were entered into this baseline cohort.

We have complete ascertainment of baseline data for the 7,462 meeting the inclusion criteria, since all had to complete the claim form (which served as baseline data for this study) in order to make an injury claim. Those persons providing written, informed consent were followed by mailed questionnaire. At six week

follow-up, 40% of this cohort (2,986 claimants) mailed back their questionnaires and constituted the follow-up study group (described in more detail below).

## 4.2 Study Design

All data in the current study were self-reported. Claimants completed a claim form which served as our baseline questionnaire and which covered information in six categories: sociodemographic characteristics, collision-related factors, prior health, post-injury symptoms, pain location and intensity, and the health care provider seen initially when they submitted claims. Eighty percent of the claimants completed this form within one month after the collision. Claimants who provided written consent also completed follow-up questionnaires sent to them approximately six weeks after the collision than again, at four months, eight months and finally, at one year after the collision. These questionnaires asked about neck pain and other pain symptoms, in addition to questions about health-related quality of life (using the SF-36, Ware and Sherbourne, 1992) and depressive symptoms (using the CES-D, Radloff, 1977). The current study includes all those who responded to the 6-week follow-up questionnaire. Detailed inclusion/exclusion criteria are listed below:

## 4.3 Inclusion Criteria

1. Persons who made a personal injury claim to SGI for a traffic-related injury sustained between July 1, 1994 and December 31, 1995, and reported neck pain (see next section) after the collision. This includes those who sought health care for a traffic injury, since health care providers are mandated to report these to SGI.
2. Persons aged 18 years and older.
3. Persons who were residents of Saskatchewan.

4. Those who provided written, informed consent to participate in the follow-up, and who responded to the 6-week follow-up questionnaire.

## 4.4 Exclusion Criteria

1. Those who died in the collision.
2. Those who filed workers' compensation claims.
3. Those who could not complete the questionnaires due to language barrier.
4. Those with more than one injury claim during the study period.
5. Those who had injuries (e.g., catastrophic head injury) or unassociated illness (e.g., Alzheimer's disease) that precluded completion of the study questionnaires
6. Those who were not injured in a motor vehicle (pedestrians, bicyclists and motorcyclists).
7. Those who were hospitalized for more than two days (i.e., those with serious injuries).

## 4.5 Case Definition for Neck Pain

The cohort for this study included claimants who answered "yes" to both of the following questions: "Did the accident cause neck or shoulder pain?" and "Have you felt neck or shoulder pain or have you felt reduced or painful neck movement since the accident?" Of the 9,006 claimants, 7,462 met this case definition at baseline.

## 4.6 Outcome Measures

In our study, pain-related emotional states (depression, anxiety, anger, frustration and fearfulness) were measured at follow-up by the use of visual-

analogue scale (VAS). Participants were asked to mark one point on a 100-mm VAS scale between "none" and "the most severe imaginable" to indicate levels of anxiety, anger, fear, frustration and depression related to their neck pain (Wade et al., 1990). Although most methods of assessing emotions utilize multi-item questionnaires, Wade (1990) reported that use of a VAS to measure pain-related emotions is a valid measure. De Boer et al. (2004) also reported that the VAS has good validity, reliability, and responsiveness compared to multi-item questionnaires in measuring quality of life (de Boer et al., 2004).

## 4.7 Potential Explanatory Factors

Potential explanatory factors included the following factors measured at baseline: frequency of pre-injury emotions (depression, anxiety, anger, frustration and fearfulness); initial pain intensity; initial pain extent; symptoms after the collision; collision-related factors; and demographic/socioeconomic factors.

Pain intensity was measured by three 100 mm visual analogue scales, on which the individual marked how much neck/shoulder, headache and other pain they experienced "usually" and "now" (Jensen et al., 1986). This is a valid and reliable method of assessing pain intensity. Pain location and extent was measured on a pain drawing, on which the individual was to shade in painful areas, and percentage of body in pain was calculated from this (Margolis et al., 1986).

Pre-injury emotions were measured using the following question: "How did you feel before the accident? ". For each pre-injury emotion there are four answers to choose from: "Never or almost never; Sometimes, every month; Very often, every week; Everyday."

## 4.8 Statistical analysis

### 4.8.1 Potential explanatory factors

Potential explanatory factors were grouped into four specific content-related domains. These domains clustered variables around: demographic and socioeconomic characteristics; general health before the injury;, collision-related factors; and initial pain severity.

Domain 1: Demographic characteristics and socioeconomic variables were: age, gender, Body Mass Index, education, combined family income, and employment status.

Domain 2: General health before the injury included: general health before the collision, prior emotional levels (depression, anxiety, anger, frustration and fearfulness); previously injured in a collision; a previous injury to the head/face; a previous injury to the arm; a previous injury to the leg in past; a previous injury to the neck/shoulder; a previous back injury; a previous injury to some other body part.

Domain 3: Collision-related factors and symptoms after collision included: Lawyer involvement, initial health care providers, whether the person was off work due to accident, symptoms of dizziness or unsteadiness, ringing in ears, or vision problems.

Domain 4: Initial pain severity was assessed using the VAS to rate neck/shoulder pain now, headache pain now, other pain now, and percentage of body in pain.

### 4.8.2 Assessment of bias due to attrition

Due to high attrition (the non-participant rate was 60%), selection bias might have been expected. To assess this potential for attrition bias, we used multivariable logistic regression to describe factors associated with participation at six weeks follow-up. The outcome was participantion at the 6-week follow-up. Our modeling strategy was as follows. From the above domains, we selected potential explanatory factors that we believed were most likely to be associated with participation. – sex, age, education, income, insurance system, seat position, impact direction, seat position, seat belt usage, % of body in pain, neck/shoulder pain intensity and lawyer involvement – that might be associated with participant status. . For each variable, a crude model was developed. Variables demonstrating a relationship with participation (with a Wald chi-square statistic of $p \leq 1.0$) were included in a multivariable logistic regression model. These variables were considered to be associated with participation if their adjusted estimates were associated with a Wald p-value of $<0.05$.

### 4.8.3 Description of the baseline characteristics for the study population

We describe the baseline characteristics of the study population at baseline. This includes all potential participants, and we also present characteristics stratified by participation in the follow-up.

### 4.8.4 Description of pain-related emotions at six week follow-up by subject characteristics

We describe the pain-related emotions experienced by the cohort, stratified by demographic, socioeconomic factors and prior health, using summary statistics. We also describe the univariate correlations among the five pain-related emotions and other factors using Pearson Product-Moment Correlation Coefficients for

continuous variables and Spearman Correlation Coefficients when one of the variables was categorical.

### 4.8.5 Multiple linear regressions for predictive factors of pain-related emotions at six week follow up.

The purpose of the analysis was to identify the variables associated with each pain-related emotion at six weeks after traffic collision. To this end, multiple linear regressions were used since the outcome was measured by visual analogue scale and they were continuous variables. Multiple linear regression attempts to model the relationship between two or more explanatory variables and a response continuous variable by fitting a linear equation to observed data.

SPSS was used to perform all statistical analysis as statistical software.

#### 4.8.5.1 Assumptions for multiple linear regressions

Quantitative statistical models always rest on assumptions about the way the world works, and regression models are no exception. There are five principal assumptions which justify the use of linear regression models for purposes of prediction:

1. Existence: for each combination of the fixed independent variables, Y is a random variable with a probability distribution having mean and variance.
2. Independence: Independent variables are statistically independent of each other.
3. Linearity: it is assumed that the relationship between dependent and independent variables is linear.
4. Normality: residuals (predicted minus observed values) are distributed normally.
5. Homoscedasticity: the errors have constant variance.

#### 4.8.5.2 Checking assumptions

1. Linearity: Bar graphs were developed to check the linearity relationship between pain-related emotions at six week follow-up and each exploratory continuous variable (age, Body Mass Index, initial pain level). Bar graphs showed a linearity trend between outcome and independent variables.

2. Normality: Normal Q-Q plots were graphed separately for five pain-related emotions at six week follow-up. Graphs showed the selected five outcomes variables had normal distribution.

3. Multicollinearity: Multicollinearity refers to any linear relationship amongst explanatory variables in a regression model. The possible correlated explanatory variables included: general health and self-reported emotional state(s) prior to injury (depressed, anxious, angry, frustrated and/or fearful). Spearman's correlation was performed to obtain the correlation coefficients for each pairwise relationship between variables. Other possible collinearity may be present between pain-related emotions at 6 weeks and pain characteristics at baseline and at 6 weeks post-injury. These correlations coefficients were computed through Pearson's correlation statistics.

#### 4.8.5.3 Building multiple linear regression models

Multiple linear regressions modeling employing a 3-stage manual approach was used to evaluate associations between prognostic factors and the dependent variable of each pain-related emotion at six week follow-up.

1. Univariate models

Each single variable within each domain was entered into a model individually to obtain its crude β and 95% confidential interval. Variables which were associated

with post-injury pain-related emotions with a $p < 0.1$ on the F-test were chosen to be used in the second phase of the modelling.

2. Domain-specified models

In the second phase of the analysis, within each domain, variables chosen from univariate models were together entered into a multivariable, domain-specific model to obtain their domain-specific adjusted βs and 95% confidential intervals. Once again, variables demonstrating a relationship with pain-related emotions at 6 weeks follow-up with an F-statistic of $p < 1.0$ were retained and entered into the final multivariable model.

3. Final multivariable linear regression model

In the final phrase of the analysis, all remaining variables were entered into a multivariable model (all domains). Adjusted β and 95% confidential intervals, F statistics, and standard deviations were obtained in the analysis.

#### 4.8.5.4 Regression Diagnostics

We used residuals to check whether assumptions were valid, that is, if errors were normally distributed and had constant variance. Studentized deleted residuals were calculated, and histogram, box plot, normal Q-Q plot and detrended normal Q-Q plot were graphed for the normality check for the residuals distribution. Also, Unstandardized Predicted Value, Centered Leverage Value and Cook's distance were computed to detect outliers and influential observations. Scatterplots were graphed using those three statistics against Studentized deleted residuals values.

# Chapter 5 Results

## 5.1 Results of the logistic regression for attrition analysis

Our multiple logistic model examining factors associated with loss to follow-up suggested that at the six-week followup, participants were most likely to be women, and to have at least a grade 12 education. Those people with a family income of <$20,000 per year, with greater pain intensity and who had consulted with a lawyer prior to making an insurance claim were less likely to be participants in at the six-week follow-up (Table 1).

Table 1 Baseline factors associated with participation at six-week follow-up. Univariate and multivariate odds ratios and 95% confidence intervals.

| Factor | Univariate OR (95%CI) | Multivariate OR (95%CI) |
|---|---|---|
| Sex | | |
| Male | 1.00 | 1.00 |
| Female | 1.52 (1.38-1.67) | 1.43 (1.29-1.59) |
| Age Group | | |
| 18-<24 | 1.00 | 1.00 |
| 24-<30 | 1.21 (1.04-1.41) | 1.09 (0.92-1.28) |
| 30-<40 | 1.28 (1.12-1.46) | 1.14 (0.96-1.30) |
| 40-<50 | 1.34 (1.15-1.55) | 1.12 (0.95-1.33) |
| 50+ | 1.17 (1.01-1.35) | 1.21 (1.02-1.44) |
| Education | | |
| Grade 8 or less | 1.00 | 1.00 |
| Higher than grade 8, did not graduate | 1.25 (0.99-1.57) | 1.24 (0.97-1.59) |

| | | |
|---|---|---|
| High school graduate | 1.70 (1.36-2.13) | 1.63 (1.27-2.09) |
| Post-secondary or some university | 2.18 (1.76-2.71) | 2.07 (1.61-2.65) |
| University graduate | 2.25 (1.76-2.88) | 1.93 (1.46-2.54) |
| Combined income (%) | | |
| Above $60,000 | 1.00 | 1.00 |
| $0 -$20,000 | 0.66 (0.56-0.77) | 0.79 (0.66-0.95) |
| $20,001-$40,000 | 0.87 (0.74-1.02) | 0.97 (0.82-1.15) |
| $40,001-$60,000 | 1.05 (0.88-1.25) | 1.10 (0.92-1.33) |
| Insurance System | | |
| Tort | 1.00 | 1.00 |
| No fault | 1.17 (1.06-1.29) | 0.96 (0.86-1.06) |
| Impact direction | | |
| front | 1.00 | 1.00 |
| rear | 1.18 (1.05-1.32) | 1.11 (0.99-1.26) |
| Driver side | 0.97 (0.84-1.11) | 0.96 (0.83-1.12) |
| Passenger side | 1.03 (0.89-1.20) | 1.03 (0.88-1.12) |
| Seat belt usage | | |
| Lap and shoulder | 1.00 | 1.00 |
| lap | 0.77 (0.62-0.95) | 0.93 (0.74-1.16) |
| no | 0.73 (0.56-0.95) | 0.99 (0.75-1.30) |
| Lawyer involvement | | |
| No | 1.00 | 1.00 |
| Yes | 0.40 (0.33-0.47) | 0.40 (0.33-0.48) |
| % of body in pain | 0.996 (0.993-0.999) | 1.00 (0.997-1.00) |
| VAS- neck/shoulder pain | 0.995 (0.993-0.996) | 0.997 (0.995-0.999) |

## 5.2 Description of the baseline ccharacteristics

### 5.2.1 Baseline population characteristics by gender

Of the 7,462 participants at baseline, 60.7% were female. Approximately half of all claimants were married/common law, and one third were currently single (both genders). The average age for men was 37.34 years and 36.84 years for women. A greater proportion of women (39.0%) had obtained a post-secondary diploma or some university education compared to men (29.3%); equal proportions (26%) of men and women were high school graduates. The majority of subjects (37.4% for males and 41.4% for females) reported annual combined family income under $20,000; one-third of subjects earned $20,001-$40,000 per year. More men (64.1%) worked full-time compared to women (41.2%), whereas more women (24.2%) than men (10.7%) were employed on a part-time basis (Table 2).

Table 2 Gender-specific frequency distribution of demographic and socioeconomic variables

| | Participants at baseline (n=7462) | |
|---|---|---|
| Variables | Male (n=2926 39.2%) | Female (n=4533 60.7%) |
| Age (years) | | |
| Mean (S.D.) | 37.34 (15.71) | 36.83 (14.56) |
| Marital Status n (% within gender) | | |
| Married or common law | 1599 (54.7%) | 2424 (53.5%) |

| | | |
|---|---|---|
| single | 1079 (36.9%) | 1415 (31.2%) |
| Separated or divorced | 206 (7.0%) | 515 (11.4%) |
| widowed | 41 (1.4%) | 178 (3.9%) |
| Education | | |
| Grade 8 or less | 229 (7.8%) | 237 (5.2%) |
| Higher than grade 8, did not graduate | 778 (26.6%) | 829 (18.3%) |
| High school graduate | 782 (26.7%) | 1187 (26.2%) |
| Post-secondary or some university | 858 (29.3%) | 1768 (39.0%) |
| University graduate | 278 (9.5%) | 511 (11.3%) |
| Combined Family Income | | |
| $0-$20,000 | 1085 (37.4%) | 1860 (41.4%) |
| $20,001-$40,000 | 947 (32.6%) | 1376 (30.7%) |
| $40,001-$60,000 | 521 (18.0%) | 790 (17.6%) |
| Above $60,000 | 349 (12.0%) | 462 (10.3%) |
| Employment Status | | |
| Full time | 1876 (64.1%) | 1867 (41.2%) |
| Student | 223 (7.6%) | 420 (9.3%) |
| Part time | 312 (10.7%) | 1098 (24.2%) |
| Homemaker | 20 (0.7%) | 743 (16.4%) |
| Retired | 221 (7.6%) | 178 (3.9%) |
| Unemployed | 273 (9.3%) | 225 (5.0%) |

### 5.2.2 Description of population stratified by prior depression

Frequencies were computed for the following demographic/socioeconomic characteristics – age group, gender, marital status, combined family income, education, employment status and initial pain intensities – and then stratified by prior depression status before the collision.

Table 3 Description of subjects stratified by prior depression status (n=7462)

| | Prior Depression | | | |
|---|---|---|---|---|
| | Never | Sometimes | Very often | Every day |
| Age | | | | |
| Mean (years) | 37.1 | 36.4 | 35.1 | 39.9 |
| S. D. | 15.1 | 14.6 | 13.3 | 14.8 |
| Gender (%) | | | | |
| Female | 83.8 | 13.7 | 1.9 | 0.6 |
| Male | 88.4 | 9.4 | 1.4 | 0.8 |
| Marital status (%) | | | | |
| Married or common law | 87.9 | 10.2 | 1.2 | 0.6 |
| single | 84.0 | 13.4 | 1.9 | 0.6 |
| Separated or divorced | 79.6 | 16.0 | 3.5 | 1.0 |
| widowed | 83.1 | 14.6 | 1.4 | 0.9 |
| Education (%) | | | | |
| Grade 8 or less | 85.0 | 13.1 | 1.3 | 0.6 |
| Higher than grade 8, did not graduate | 83.4 | 13.1 | 2.6 | 0.9 |
| High school | 85.7 | 12.0 | 1.7 | 0.7 |

| | | | | |
|---|---|---|---|---|
| graduate | | | | |
| Post-secondary or some university | 85.7 | 12.1 | 1.6 | 0.6 |
| University graduate | 90.0 | 9.0 | 0.4 | 0.6 |
| Combined income (%) | | | | |
| $0 -$20,000 | 81.7 | 14.8 | 2.6 | 1.0 |
| $20,001-$40,000 | 86.6 | 11.5 | 1.3 | 0.5 |
| $40,001-$60,000 | 90.4 | 8.2 | 1.1 | 0.2 |
| Above $60,000 | 89.5 | 9.2 | 0.6 | 0.6 |
| Employment status (%) | | | | |
| Full time | 88.2 | 10.1 | 1.3 | 0.4 |
| Part time | 85.5 | 12.2 | 1.6 | 0.7 |
| Homemaker | 80.8 | 16.4 | 2.0 | 0.8 |
| Student | 84.1 | 14.0 | 1.6 | 0.3 |
| Unemployed | 74.6 | 17.9 | 5.0 | 2.4 |
| Retired | 86.7 | 11.1 | 1.0 | 1.3 |
| Prior health status (%) | | | | |
| Excellent | 92.6 | 6.7 | 0.5 | 0.2 |
| Very good | 86.5 | 12.3 | 1.0 | 0.2 |
| Good | 78.3 | 18.1 | 2.7 | 0.9 |
| Fair | 61.7 | 26.7 | 8.0 | 3.7 |
| Poor | 31.5 | 24.7 | 24.7 | 19.2 |
| Prior anxiety (%) | | | | |
| Never | 92.7 | 6.6 | 0.6 | 0.1 |
| Sometimes | 54.6 | 41.6 | 3.0 | 0.8 |
| Very often | 27.2 | 33.3 | 35.4 | 4.1 |
| Every day | 21.1 | 15.8 | 14.0 | 49.1 |
| Prior anger (%) | | | | |

| | | | | |
|---|---|---|---|---|
| Never | 92.5 | 6.6 | 0.7 | 0.2 |
| Sometimes | 62.9 | 33.5 | 3.1 | 0.5 |
| Very often | 30.9 | 36.9 | 25.5 | 6.7 |
| Every day | 8.3 | 16.7 | 19.4 | 55.6 |
| Prior frustration (%) | | | | |
| Never | 94.4 | 5.0 | 0.5 | 0.1 |
| Sometimes | 65.6 | 31.9 | 2.0 | 0.5 |
| Very often | 33.8 | 36.8 | 23.5 | 5.9 |
| Every day | 18.8 | 17.4 | 23.2 | 40.6 |
| Prior fear (%) | | | | |
| Never | 89.8 | 9.1 | 0.9 | 0.3 |
| Sometimes | 47.5 | 46.4 | 4.5 | 1.6 |
| Very often | 22.1 | 26.5 | 44.1 | 7.4 |
| Every day | 19.0 | 9.5 | 23.8 | 47.6 |
| Initial pain intensity | | | | |
| Neck pain now | | | | |
| Mean | 56.7 | 58.1 | 63.6 | 67.7 |
| S.D. | 25.0 | 24.8 | 23.6 | 23.5 |
| Headache now | | | | |
| Mean | 36.7 | 40.1 | 47.9 | 47.0 |
| S.D. | 33.9 | 33.8 | 34.5 | 36.6 |
| Other Pain now | | | | |
| Mean | 41.4 | 44.3 | 52.9 | 57.5 |
| S.D. | 34.3 | 33.7 | 33.6 | 35.4 |
| % of body in pain | | | | |
| Mean | 20.6 | 23.2 | 26.1 | 33.6 |
| S.D. | 15.1 | 15.7 | 18.1 | 26.3 |

### 5.2.3 Description of population stratified by prior anxiety

Frequencies were computed for the following demographic/socioeconomic characteristics – age group, gender, marital status, combined family income, education, employment status, and initial pain intensities – and then stratified by prior anxiety status before the collision.

Table 4 Description of subjects by prior anxiety status (n=7462)

| | Prior Anxiety | | | |
|---|---|---|---|---|
| | Never | Sometimes | Very often | Every day |
| Age | | | | |
| Mean (year) | 36.9 | 37.6 | 36.3 | 40.9 |
| S. D. | 15.0 | 15.4 | 14.3 | 16.5 |
| Gender (%) | | | | |
| Female | 82.0 | 15.0 | 2.4 | 0.6 |
| Male | 85.8 | 11.9 | 1.3 | 1.0 |
| Marital status (%) | | | | |
| Married or common law | 84.8 | 12.9 | 1.5 | 0.7 |
| single | 82.5 | 14.6 | 2.2 | 0.7 |
| Separated or divorced | 80.7 | 15.1 | 3.3 | 0.8 |
| widowed | 80.8 | 15.1 | 2.7 | 1.4 |
| Education (%) | | | | |
| Grade 8 or less | 82.0 | 14.2 | 2.6 | 1.3 |
| Higher than grade 8, did not graduate | 81.0 | 15.2 | 2.9 | 0.9 |
| High school graduate | 84.2 | 13.3 | 1.7 | 0.9 |
| Post-secondary or | 83.4 | 14.1 | 0.9 | 0.5 |

| | | | | |
|---|---|---|---|---|
| some university | | | | |
| University graduate | 88.1 | 10.6 | 0.6 | 0.6 |
| Combined income (%) | | | | |
| $0 -$20,000 | 81.1 | 15.4 | 2.5 | 1.0 |
| $20,001-$40,000 | 83.8 | 13.7 | 1.8 | 0.7 |
| $40,001-$60,000 | 87.0 | 11.0 | 1.5 | 0.5 |
| Above $60,000 | 86.1 | 12.1 | 1.2 | 0.6 |
| Employment status (%) | | | | |
| Full time | 85.6 | 12.2 | 1.7 | 0.6 |
| Part time | 84.4 | 13.4 | 1.4 | 0.8 |
| Homemaker | 79.1 | 17.1 | 3.3 | 0.5 |
| Student | 80.4 | 17.1 | 2.0 | 0.5 |
| Unemployed | 75.1 | 18.5 | 5.0 | 1.4 |
| Retired | 84.4 | 12.8 | 0.8 | 2.0 |
| Prior health status (%) | | | | |
| Excellent | 90.2 | 8.9 | 0.5 | 0.4 |
| Very good | 84.6 | 13.6 | 1.6 | 0.3 |
| Good | 75.2 | 21.0 | 2.8 | 1.0 |
| Fair | 60.7 | 25.2 | 10.4 | 3.7 |
| Poor | 48.6 | 17.6 | 20.3 | 13.5 |
| Prior depression (%) | | | | |
| Never | 90.4 | 8.8 | 0.6 | 0.2 |
| Sometimes | 45.9 | 47.7 | 5.5 | 1.0 |
| Very often | 27.8 | 24.6 | 41.3 | 6.3 |
| Every day | 17.6 | 15.7 | 11.8 | 54.9 |
| Prior anger (%) | | | | |
| Never | 90.9 | 8.0 | 0.8 | 0.3 |
| Sometimes | 57.3 | 37.8 | 4.0 | 0.9 |
| Very often | 35.3 | 28.7 | 28.0 | 8.0 |

| | | | | |
|---|---|---|---|---|
| Every day | 13.9 | 19.4 | 16.7 | 50.0 |
| Prior frustration (%) | | | | |
| Never | 92.9 | 6.4 | 0.5 | 0.1 |
| Sometimes | 60.8 | 35.8 | 2.9 | 0.5 |
| Very often | 37.1 | 30.2 | 26.8 | 5.9 |
| Every day | 23.2 | 13.0 | 21.7 | 42.0 |
| Prior fear (%) | | | | |
| Never | 88.4 | 10.3 | 1.0 | 0.3 |
| Sometimes | 37.2 | 55.0 | 6.4 | 1.5 |
| Very often | 16.2 | 25.0 | 50.0 | 8.8 |
| Every day | 14.3 | 11.9 | 21.4 | 52.4 |
| Initial pain intensity | | | | |
| Neck pain now | | | | |
| Mean | 57.0 | 57.3 | 59.6 | 64.1 |
| S.D. | 25.1 | 24.6 | 24.4 | 23.1 |
| Headache now | | | | |
| Mean | 36.9 | 38.9 | 41.7 | 47.2 |
| S.D. | 34.0 | 34.2 | 34.2 | 34.8 |
| Other Pain now | | | | |
| Mean | 41.4 | 44.3 | 46.0 | 54.7 |
| S.D. | 34.2 | 34.2 | 33.0 | 37.8 |
| % of body in pain | | | | |
| Mean | 20.6 | 22.9 | 26.6 | 30.3 |
| S.D. | 14.9 | 16.5 | 18.1 | 24.1 |

### 5.2.4 Description of population stratified by prior anger

Frequencies were computed for the following demographic/socioeconomic characteristics – age group, gender, marital status, combined family income, education, employment status, and initial pain intensities – and then stratified by prior anger status before the collision.

Table 5 Description of subjects by prior anger status (n=7462)

| | Prior Anger | | | |
|---|---|---|---|---|
| | Never | Sometimes | Very often | Every day |
| Age | | | | |
| Mean (year) | 37.6 | 35.2 | 32.4 | 36.6 |
| S. D. | 15.2 | 14.3 | 13.0 | 10.9 |
| Gender (%) | | | | |
| Female | 78.8 | 18.7 | 2.1 | 0.4 |
| Male | 81.4 | 16.1 | 1.9 | 0.6 |
| Marital status (%) | | | | |
| Married or common law | 80.5 | 17.3 | 1.7 | 0.5 |
| single | 78.0 | 19.0 | 2.6 | 0.4 |
| Separated or divorced | 81.3 | 16.0 | 2.2 | 0.6 |
| widowed | 84.9 | 14.2 | 0.9 | 0.0 |
| Education (%) | | | | |
| Grade 8 or less | 80.4 | 17.4 | 1.5 | 0.6 |
| Higher than grade 8, did not graduate | 77.1 | 19.7 | 2.7 | 0.6 |
| High school graduate | 79.6 | 17.9 | 2.0 | 0.6 |
| Post-secondary or some | 80.0 | 17.7 | 1.9 | 0.4 |

| | | | | |
|---|---|---|---|---|
| university | | | | |
| University graduate | 85.4 | 13.1 | 1.3 | 0.3 |
| Combined income (%) | | | | |
| $0 -$20,000 | 76.6 | 20.2 | 2.7 | 0.5 |
| $20,001-$40,000 | 81.8 | 15.8 | 1.8 | 0.6 |
| $40,001-$60,000 | 81.5 | 16.5 | 1.6 | 0.4 |
| Above $60,000 | 83.4 | 15.5 | 1.0 | 0.1 |
| Employment status (%) | | | | |
| Full time | 81.5 | 16.3 | 1.8 | 0.5 |
| Part time | 78.8 | 19.4 | 1.7 | 0.1 |
| Homemaker | 77.7 | 19.7 | 2.2 | 0.4 |
| Student | 77.1 | 19.8 | 3.0 | 0.2 |
| Unemployed | 73.5 | 20.5 | 3.8 | 2.2 |
| Retired | 85.2 | 13.6 | 1.0 | 0.3 |
| Prior health status (%) | | | | |
| Excellent | 84.4 | 14.5 | 1.1 | 0.1 |
| Very good | 79.7 | 18.4 | 1.6 | 0.3 |
| Good | 75.5 | 21.3 | 2.7 | 0.5 |
| Fair | 67.0 | 22.9 | 7.0 | 3.1 |
| Poor | 48.6 | 23.0 | 16.2 | 12.2 |
| Prior depression (%) | | | | |
| Never | 86.3 | 12.9 | 0.7 | 0.0 |
| Sometimes | 44.0 | 49.2 | 6.1 | 0.7 |
| Very often | 31.7 | 32.5 | 30.2 | 5.6 |
| Every day | 27.5 | 13.7 | 19.6 | 39.2 |
| Prior anxiety (%) | | | | |
| Never | 87.0 | 12.1 | 0.9 | 0.1 |
| Sometimes | 46.7 | 48.4 | 4.2 | 0.7 |
| Very often | 32.4 | 35.1 | 28.4 | 4.1 |

| | | | | |
|---|---|---|---|---|
| Every day | 26.3 | 21.1 | 21.1 | 31.6 |
| Prior frustration (%) | | | | |
| Never | 95.7 | 4.0 | 0.3 | 0.0 |
| Sometimes | 37.2 | 61.1 | 1.6 | 0.1 |
| Very often | 22.9 | 31.2 | 44.9 | 1.0 |
| Every day | 21.7 | 10.1 | 21.7 | 46.4 |
| Prior fear (%) | | | | |
| Never | 85.2 | 13.6 | 1.0 | 0.2 |
| Sometimes | 26.1 | 66.3 | 6.5 | 1.1 |
| Very often | 25.0 | 27.9 | 45.6 | 1.5 |
| Every day | 19.0 | 14.3 | 26.2 | 40.5 |
| Initial pain intensity | | | | |
| Neck pain now | | | | |
| Mean | 56.9 | 57.0 | 62.4 | 75.1 |
| S.D. | 25.0 | 24.9 | 25.3 | 19.0 |
| Headache now | | | | |
| Mean | 36.9 | 37.7 | 48.2 | 55.4 |
| S.D. | 33.9 | 33.7 | 37.6 | 55.4 |
| Other Pain now | | | | |
| Mean | 41.4 | 43.1 | 52.0 | 58.8 |
| S.D. | 34.3 | 34.0 | 33.9 | 36.1 |
| % of body in pain | | | | |
| Mean | 20.7 | 22.1 | 25.4 | 36.5 |
| S.D. | 15.2 | 15.3 | 17.3 | 28.5 |

### 5.2.5 Description of population stratified by prior frustration

Frequencies were computed for the following demographic/socioeconomic characteristics – age group, gender, marital status, combined family income, education, employment status, and initial pain intensities – and then stratified by prior frustration status before the collision.

Table 6 Description of subjects stratified by prior frustration status (n=7462)

| | Prior Frustration | | | |
|---|---|---|---|---|
| | Never | Sometimes | Very often | Every day |
| Age | | | | |
| Mean (year) | 37.5 | 35.9 | 33.6 | 34.4 |
| S. D. | 15.3 | 14.2 | 13.6 | 12.1 |
| Gender (%) | | | | |
| Female | 71.9 | 24.2 | 3.0 | 0.9 |
| Male | 77.0 | 19.7 | 2.4 | 1.0 |
| Marital status (%) | | | | |
| Married or common law | 75.1 | 21.6 | 2.4 | 0.9 |
| single | 72.2 | 23.4 | 3.3 | 1.1 |
| Separated or divorced | 71.5 | 24.8 | 3.1 | 0.7 |
| widowed | 78.5 | 19.2 | 2.3 | 0.0 |
| Education (%) | | | | |
| Grade 8 or less | 78.1 | 18.1 | 3.0 | 0.9 |
| Higher than grade 8, did not graduate | 71.4 | 24.3 | 2.8 | 1.6 |
| High school graduate | 73.9 | 22.6 | 2.5 | 0.9 |
| Post-secondary or some university | 73.3 | 23.0 | 3.1 | 0.6 |

| | | | | |
|---|---|---|---|---|
| University graduate | 78.4 | 19.0 | 1.8 | 0.8 |
| Combined income (%) | | | | |
| $0 -$20,000 | 70.5 | 24.9 | 3.5 | 1.1 |
| $20,001-$40,000 | 75.2 | 21.5 | 2.5 | 0.9 |
| $40,001-$60,000 | 77.3 | 20.1 | 2.1 | 0.4 |
| Above $60,000 | 77.4 | 20.0 | 1.6 | 1.0 |
| Employment status (%) | | | | |
| Full time | 75.2 | 21.6 | 2.3 | 0.8 |
| Part time | 72.8 | 24.1 | 2.5 | 0.6 |
| Homemaker | 70.5 | 25.4 | 3.2 | 0.9 |
| Student | 72.0 | 23.8 | 3.4 | 0.8 |
| Unemployed | 66.9 | 24.5 | 5.6 | 3.0 |
| Retired | 83.2 | 14.1 | 2.3 | 0.5 |
| Prior health status (%) | | | | |
| Excellent | 80.8 | 17.5 | 1.3 | 0.4 |
| Very good | 73.7 | 23.9 | 2.1 | 0.4 |
| Good | 67.7 | 27.9 | 3.6 | 0.8 |
| Fair | 53.5 | 29.1 | 11.0 | 6.4 |
| Poor | 21.6 | 29.7 | 28.4 | 20.3 |
| Prior depression (%) | | | | |
| Never | 81.5 | 17.2 | 1.1 | 0.2 |
| Sometimes | 30.7 | 59.6 | 8.4 | 1.3 |
| Very often | 22.2 | 27.0 | 38.1 | 12.7 |
| Every day | 5.9 | 15.7 | 23.5 | 54.9 |
| Prior anxiety (%) | | | | |
| Never | 82.2 | 16.3 | 1.2 | 0.3 |
| Sometimes | 34.6 | 58.4 | 6.0 | 0.9 |
| Very often | 20.3 | 32.4 | 37.2 | 10.1 |
| Every day | 12.3 | 15.8 | 21.1 | 50.9 |

| | | | | |
|---|---|---|---|---|
| Prior anger (%) | | | | |
| Never | 88.5 | 10.5 | 0.8 | 0.3 |
| Sometimes | 16.7 | 77.9 | 4.9 | 0.5 |
| Very often | 11.3 | 17.3 | 61.3 | 10.0 |
| Every day | 0.0 | 5.6 | 5.6 | 88.9 |
| Prior fear (%) | | | | |
| Never | 80.0 | 18.0 | 1.6 | 0.4 |
| Sometimes | 12.0 | 77.9 | 8.0 | 2.2 |
| Very often | 8.8 | 22.1 | 58.8 | 10.3 |
| Every day | 2.4 | 9.5 | 26.2 | 61.9 |
| Initial pain intensity | | | | |
| Neck pain now | | | | |
| Mean | 56.9 | 56.8 | 60.7 | 70.1 |
| S.D. | 24.9 | 25.3 | 25.1 | 23.3 |
| Headache now | | | | |
| Mean | 37.0 | 37.5 | 41.6 | 54.2 |
| S.D. | 34.0 | 33.7 | 36.5 | 35.3 |
| Other Pain now | | | | |
| Mean | 41.0 | 44.2 | 48.2 | 57.9 |
| S.D. | 34.2 | 34.1 | 34.4 | 34.1 |
| % of body in pain | | | | |
| Mean | 20.3 | 22.7 | 25.3 | 31.6 |
| S.D. | 14.9 | 15.9 | 17.8 | 24.5 |

### 5.2.6 Description of population stratified by prior fear

Frequencies were computed for the following demographic/socioeconomic characteristics – age group, gender, marital status, combined family income, education, employment status, and initial pain intensities – and then stratified by prior fear status before the accident.

Table 7 Description of subjects by prior fear status (n=7462)

| | Prior Fear | | | |
|---|---|---|---|---|
| | Never | Sometimes | Very often | Every day |
| Age | | | | |
| Mean (year) | 37.1 | 36.8 | 34.5 | 37.1 |
| S. D. | 15.0 | 15.7 | 13.7 | 11.7 |
| Gender (%) | | | | |
| Female | 89.5 | 8.9 | 1.0 | 0.6 |
| Male | 93.6 | 5.2 | 0.8 | 0.5 |
| Marital status (%) | | | | |
| Married or common law | 92.3 | 6.5 | 0.7 | 0.6 |
| single | 90.1 | 8.1 | 1.1 | 0.6 |
| Separated or divorced | 89.7 | 8.6 | 1.3 | 0.4 |
| widowed | 86.8 | 11.9 | 1.4 | 0.0 |
| Education (%) | | | | |
| Grade 8 or less | 88.2 | 10.1 | 1.1 | 0.6 |
| Higher than grade 8, did not graduate | 89.2 | 9.0 | 1.2 | 0.7 |
| High school graduate | 91.7 | 6.9 | 0.9 | 0.6 |
| Post-secondary or some | 91.6 | 7.1 | 0.8 | 0.5 |

| | | | | |
|---|---|---|---|---|
| university | | | | |
| University graduate | 93.8 | 4.9 | 0.6 | 0.6 |
| Combined income (%) | | | | |
| $0 -$20,000 | 88.7 | 9.5 | 1.3 | 0.6 |
| $20,001-$40,000 | 92.8 | 6.1 | 0.5 | 0.6 |
| $40,001-$60,000 | 92.7 | 5.8 | 1.2 | 0.3 |
| Above $60,000 | 93.2 | 6.1 | 0.4 | 0.4 |
| Employment status (%) | | | | |
| Full time | 93.1 | 5.6 | 0.7 | 0.5 |
| Part time | 90.3 | 8.9 | 0.4 | 0.3 |
| Homemaker | 87.8 | 10.5 | 1.1 | 0.7 |
| Student | 88.8 | 9.6 | 1.1 | 0.5 |
| Unemployed | 85.9 | 9.2 | 3.2 | 1.6 |
| Retired | 92.2 | 6.5 | 0.8 | 0.5 |
| Prior health status (%) | | | | |
| Excellent | 94.6 | 5.0 | 0.2 | 0.2 |
| Very good | 91.9 | 7.2 | 0.6 | 0.3 |
| Good | 87.8 | 10.3 | 1.4 | 0.5 |
| Fair | 77.4 | 15.6 | 3.7 | 3.4 |
| Poor | 54.2 | 18.1 | 15.3 | 12.5 |
| Prior depression (%) | | | | |
| Never | 95.5 | 4.1 | 0.2 | 0.1 |
| Sometimes | 68.9 | 28.6 | 2.0 | 0.4 |
| Very often | 48.4 | 19.8 | 23.8 | 7.9 |
| Every day | 33.3 | 17.6 | 9.8 | 39.2 |
| Prior anxiety (%) | | | | |
| Never | 96.4 | 3.3 | 0.2 | 0.1 |
| Sometimes | 68.3 | 29.6 | 1.7 | 0.5 |
| Very often | 46.6 | 24.0 | 23.3 | 6.2 |

| | | | | |
|---|---|---|---|---|
| Every day | 36.8 | 14.0 | 10.5 | 38.6 |
| Prior anger (%) | | | | |
| Never | 97.2 | 2.4 | 0.3 | 0.1 |
| Sometimes | 70.2 | 27.9 | 1.4 | 0.5 |
| Very often | 47.7 | 24.2 | 20.8 | 7.4 |
| Every day | 33.3 | 16.7 | 2.8 | 47.2 |
| Prior frustration (%) | | | | |
| Never | 98.7 | 1.2 | 0.1 | 0.0 |
| Sometimes | 73.1 | 25.7 | 0.9 | 0.2 |
| Very often | 53.4 | 21.6 | 19.6 | 5.4 |
| Every day | 34.8 | 17.4 | 10.1 | 37.7 |
| Initial pain intensity | | | | |
| Neck pain now | | | | |
| Mean | 56.9 | 58.0 | 59.8 | 71.4 |
| S.D. | 24.9 | 26.0 | 25.6 | 25.4 |
| Headache now | | | | |
| Mean | 37.2 | 37.0 | 45.3 | 49.7 |
| S.D. | 33.9 | 34.5 | 33.9 | 39.0 |
| Other Pain now | | | | |
| Mean | 41.5 | 45.6 | 51.7 | 59.8 |
| S.D. | 34.2 | 34.7 | 34.0 | 34.2 |
| % of body in pain | | | | |
| Mean | 20.7 | 24.0 | 27.6 | 37.9 |
| S.D. | 15.0 | 17.4 | 16.5 | 26.6 |

### 5.2.7 Summary

We noted that average neck pain intensity at baseline was greater in those with reporting greater emotional distress prior to the injury (Table 8). Interesting those with prior anger, frustration and fear appear to report slightly more initial pain than those with prior depression and anxiety.

Table 8. Mean neck pain intensity at baseline stratified by frequency of emotions prior to the injury. Neck pain intensity was assessed on a 100 mm VAS.

| Mean (S.D) | Never | Sometimes | Very often | Everyday |
|---|---|---|---|---|
| Pior depression | 56.7 (25.0) | 58.1 (24.8) | 63.6 (23.6) | 67.7 (23.5) |
| Prior anxiety | 57.0 (25.1) | 57.3 (24.6) | 59.6 (24.4) | 64.1 (23.1) |
| Prior anger | 56.9 (25.0) | 57.0 (25.0) | 62.4 (25.3) | 75.1 (19.0) |
| Prior frustration | 56.9 (24.9) | 56.8 (25.3) | 60.7 (25.1) | 70.1 (23.3) |
| Prior fear | 56.9 (24.9) | 58.0 (26.0) | 59.8 (25.6) | 71.4 (25.4) |

### 5.2.8 Description of baseline population by participant status at six weeks

Table 9 Description of male and female subjects stratified by participant status at six weeks (n=7459)

| | Participants (n=2986 40%) | | Non participants (n=4473 60%) | |
|---|---|---|---|---|
| Variables | Male (n=995 33.3%) | Female (n=1991 66.7%) | Male (n=1931 43.2%) | Female (n=2541 56.8%) |
| Age (years) | | | | |
| Mean (S.D.) | 38.6 (15.7) | 36.8 (14.0) | 36.7 (15.7) | 36.9 (15.0) |
| Marital status n (% within male and female) | | | | |
| Married or common law | 586 (34.5) | 1114 (65.5) | 1013 (43.6) | 1310 (56.4) |
| single | 335 (35.4) | 610 (64.6) | 744 (48.0) | 805 (52.0) |
| Separated or divorced | 59 (22.0) | 209 (78.0) | 147 (32.5) | 306 (67.5) |
| widowed | 15 (20.5) | 58 (79.5) | 26 (17.8) | 120 (82.2) |
| Education | | | | |
| Grade 8 or less | 63 (48.8) | 66 (51.2) | 166 (49.3) | 171 (50.7) |
| Higher than grade 8, did not graduate | 235 (45.3) | 284 (54.7) | 543 (49.9) | 545 (50.1) |
| High school graduate | 260 (33.5) | 517 (66.5) | 522 (43.8) | 670 (56.2) |
| Post-secondary or | 329 (27.5) | 867 (72.5) | 529 (37.0) | 901 (63.0) |

| | | | | |
|---|---|---|---|---|
| some university | | | | |
| University graduate | 108 (29.6) | 257 (70.4) | 170 (40.1) | 254 (59.9) |
| Combined income | | | | |
| $0 -$20,000 | 316 (30.7) | 712 (69.3) | 769 (40.1) | 1148 (59.9) |
| $20,001-$40,000 | 343 (35.7) | 619 (64.3) | 604 (44.4) | 757 (55.6) |
| $40,001-$60,000 | 194 (32.1) | 411 (67.9) | 327 (46.3) | 379 (53.7) |
| Above $60,000 | 135 (37.0) | 230 (63.0) | 214 (48.0) | 232 (52.0) |
| Employment status | | | | |
| Full time | 651 (42.7) | 873 (57.3) | 1225 (55.2) | 994 (44.8) |
| Student | 74 (29.6) | 176 (70.4) | 149 (37.9) | 244 (62.1) |
| Part time | 96 (16.3) | 494 (83.7) | 216 (26.3) | 604 (73.7) |
| Homemaker | 8 (2.7) | 284 (97.3) | 12 (2.5) | 459 (97.5) |
| Retired | 88 (56.1) | 69 (43.9) | 133 (55.0) | 109 (45.0) |
| Unemployed | 78 (45.3) | 94 (54.7) | 195 (59.8) | 131 (40.2) |
| Prior health status | | | | |
| Excellent | 430 (36.5) | 748 (63.5) | 911 (50.1) | 907 (49.9) |
| Very good | 339 (32.3) | 712 (67.7) | 603 (41.2) | 860 (58.8) |
| Good | 179 (28.9) | 441 (71.1) | 326 (35.5) | 593 (64.5) |
| Fair | 39 (33.3) | 78 (66.7) | 67 (31.8) | 144 (68.2) |
| Poor | 8 (42.1) | 11 (57.9) | 19 (34.5) | 36 (65.5) |
| Pain related depression at 6 weeks (VAS) | | | | |
| Mean (S.D) | 30.9 (31.4) | 33.1 (32.0) | n/a | n/a |
| Median | 18.0 | 22.0 | n/a | n/a |
| Pain related anxiety at 6 | | | | |

| | | | | |
|---|---|---|---|---|
| weeks (VAS) | | | | |
| Mean (S.D) | 37.2 (28.0) | 37.3 (27.5) | n/a | n/a |
| Median | 36.0 | 35.0 | n/a | n/a |
| Pain related anger at 6 weeks (VAS) | | | | |
| Mean (S.D) | 41.0 (32.2) | 42.5 (33.3) | n/a | n/a |
| Median | 37.0 | 40.0 | n/a | n/a |
| Pain related frustration at 6 weeks (VAS) | | | | |
| Mean (S.D) | 50.3 (33.0) | 53.0 (32.4) | n/a | n/a |
| Median | 53.0 | 56.0 | n/a | n/a |
| Pain related fear at 6 weeks (VAS) | | | | |
| Mean (S.D) | 30.6 (30.4) | 33.2 (30.8) | n/a | n/a |
| Median | 19.0 | 23.0 | n/a | n/a |
| Initial neck pain (VAS) | | | | |
| Mean (S. D.) | 53.1(24.2) | 56.0 (24.5) | 55.8 (25.4) | 60.6 (25.0) |
| Initial headache pain (VAS) | | | | |
| Mean (S. D.) | 30.4 (31.6) | 36.7 (33.2) | 35.0 (33.9) | 42.4 (34.9) |
| Initial other pain (VAS) | | | | |
| Mean (S. D.) | 37.7 (33.7) | 40.7 (33.4) | 40.5 (34.1) | 46.0 (34.9) |
| Initial % body in pain (VAS) | | | | |
| Mean (S. D.) | 18.0 (12.9) | 21.8 (15.2) | 19.3 (14.7) | 23.1 (16.5) |
| Neck pain at 6 weeks (VAS) | | | | |

| | | | | |
|---|---|---|---|---|
| Mean (S. D.) | 38.2 (27.0) | 42.5 (27.3) | n/a | n/a |
| Headache pain at 6 weeks (VAS) | | | | |
| Mean (S. D.) | 23.5 (28.8) | 30.3 (31.6) | n/a | n/a |
| Other pain at 6 weeks (VAS) | | | | |
| Mean (S. D.) | 27.8 (30.6) | 30.4 (30.9) | n/a | n/a |
| % body in pain at 6 weeks (VAS) | | | | |
| Mean (S. D.) | 15.5 (12.8) | 20.2 (16.9) | n/a | n/a |

### 5.2.9 Summary

Mean intensity (and standard deviations) of pain-related emotions at six weeks post-injury were computed and stratified by gender (Table 10).

It appears that the intensity of frustration and anger at six weeks after collision were much higher compared to the intensity of depression, anxiety or and fear. This was true for both men and women (Table 10). For frustration, the VAS mean scores and standard deviations were 50.3 (33.0) for males and 53.0 (32.4) for females; for anger, the mean VAS scores and standard deviations were and 41.0 (32.2) for males and 42.5 (33.3) for females. We also found that, compared to males, females had statistically higher mean scores for frustration and fear.

Table 10 Means and standard deviation for pain-related emotions at 6 weeks follow up by gender (Pain-related emotions assessed on a 100 mm VAS) (t-statistic and p-value).

| VAS mean (S.D) | Male | Female | t | p |
|---|---|---|---|---|
| Depression | 30.9 (31.4) | 33.1 (32.0) | -1.608 | 0.108 |
| Anxiety | 37.2 (28.0) | 37.3 (27.5) | -0.089 | 0.929 |
| Anger | 41.0 (32.2) | 42.5 (33.3) | -1.092 | 0.275 |
| Frustration | 50.3 (33.0) | 53.0 (32.4) | -1.984 | 0.047 |
| Fear | 30.6 (30.4) | 33.2 (30.8) | -2.008 | 0.045 |

## 5.3 Description of pain-related emotions by subject characteristics at six week follow-up

Table 11 Pain-related emotions at six weeks post-injury. Means and standard deviations (S.D.) by subject characteristics

| | Six weeks emotions: Mean (S.D.) | | | | |
|---|---|---|---|---|---|
| Variables | Anxiety | Anger | Fear | Frustration | Depression |
| Age | | | | | |
| 18 - < 24 | 39.2 (26.4) | 50.0 (32.3) | 37.2 (31.0) | 57.7 (31.5) | 36.7 (32.2) |
| 24 - < 30 | 37.0 (27.6) | 44.1 (32.4) | 31.4 (30.0) | 54.0 (32.3) | 30.8 (31.4) |
| 30 - < 40 | 37.5 (28.8) | 41.4 (33.3) | 32.2 (31.7) | 52.3 (33.6) | 32.2 (32.4) |
| 40 - < 50 | 38.0 (27.0) | 40.1 (32.2) | 32.0 (29.8) | 51.6 (31.8) | 33.4 (32.6) |
| 50 + | 34.4 (27.8) | 33.2 (32.1) | 28.0 (29.5) | 44.0 (32.2) | 27.8 (29.4) |
| Marital status | | | | | |
| Married or common law | 35.7 (27.6) | 39.1 (32.7) | 30.1 (29.8) | 49.6 (32.9) | 29.7 (31.2) |
| single | 38.9 (27.0) | 46.7 (32.9) | 35.3 (31.4) | 55.8 (31.9) | 35.1 (31.8) |
| Separated or divorced | 40.9 (28.4) | 44.6 (32.2) | 36.4 (31.9) | 56.8 (31.9) | 38.6 (33.1) |
| widowed | 40.3 (31.7) | 36.8 (35.5) | 32.1 (32.7) | 44.1 (33.0) | 35.7 (34.9) |
| Education | | | | | |
| Grade 8 or less | 42.4 (29.7) | 37.7 (34.1) | 33.7 (33.8) | 45.8 (34.3) | 37.6 (32.6) |
| Higher than grade 8, did not graduate | 42.4 (29.4) | 48.0 (34.0) | 37.1 (32.3) | 56.0 (33.6) | 38.4 (33.4) |
| High school graduate | 39.7 (27.6) | 45.0 (33.4) | 34.9 (31.1) | 54.3 (32.5) | 33.6 (31.9) |
| Post-secondary or some university | 35.7 (26.6) | 41.0 (32.4) | 31.0 (29.9) | 52.0 (32.2) | 31.2 (31.4) |

| | | | | | |
|---|---|---|---|---|---|
| University graduate | 28.4 (25.1) | 31.2 (28.8) | 23.8 (26.4) | 44.1 (31.2) | 23.2 (27.9) |
| Combined income | | | | | |
| Above $60,000 | 31.9 (26.2) | 37.1 (31.9) | 27.1 (29.3) | 46.8 (33.4) | 26.6 (30.4) |
| $0 -$20,000 | 42.4 (28.4) | 49.2 (33.3) | 38.2 (32.3) | 57.3 (32.4) | 39.5 (33.2) |
| $20,001-$40,000 | 36.0 (26.9) | 39.9 (32.1) | 31.0 (29.3) | 50.9 (31.9) | 30.7 (30.7) |
| $40,001-$60,000 | 34.2 (27.2) | 36.1 (32.2) | 27.8 (29.4) | 48.4 (32.7) | 26.8 (29.9) |
| Employment status | | | | | |
| Full time | 37.2 (27.5) | 41.6 (32.7) | 32.0 (30.6) | 52.4 (32.5) | 31.8 (31.6) |
| Student | 38.5 (28.3) | 45.9 (32.3) | 35.3 (31.5) | 54.3 (32.1) | 33.8 (32.7) |
| Part time | 35.7 (26.7) | 41.6 (32.8) | 31.8 (29.9) | 51.1 (32.6) | 30.3 (30.7) |
| Homemaker | 37.0 (28.5) | 41.2 (34.1) | 30.1 (30.3) | 51.3 (32.7) | 31.9 (33.4) |
| Retired | 37.5 (29.3) | 31.8 (31.9) | 28.5 (29.7) | 41.0 (31.5) | 29.3 (29.5) |
| Unemployed | 41.7 (28.0) | 50.2 (33.0) | 39.6 (33.0) | 60.7 (32.8) | 44.9 (33.0) |
| Prior health status | | | | | |
| Excellent | 35.5 (27.9) | 41.2 (32.9) | 30.8 (30.4) | 50.2 (33.1) | 29.1 (31.4) |
| Very good | 36.9 (26.8) | 41.3 (32.8) | 31.6 (30.1) | 52.5 (32.7) | 32.1 (31.3) |
| Good | 39.0 (27.7) | 42.0 (33.0) | 34.0 (31.0) | 52.4 (32.0) | 35.7 (32.0) |
| Fair | 45.6 (27.8) | 51.1 (32.5) | 40.6 (33.0) | 61.9 (29.7) | 42.4 (32.1) |
| Poor | 65.2 (65.2) | 78.5 (20.4) | 67.5 (20.9) | 79.7 (18.4) | 78.9 (21.4) |
| Prior depression | | | | | |
| Never | 36.4 (27.2) | 40.9 (32.5) | 31.2 (30.1) | 51.2 (32.4) | 30.1 (30.7) |
| Sometimes | 41.2 (28.8) | 47.6 (35.2) | 38.4 (32.7) | 56.5 (33.6) | 44.2 (34.8) |
| Very often | 48.1 (34.8) | 51.4 (35.3) | 44.0 (33.9) | 64.3 (33.1) | 49.2 (36.7) |
| Every day | 52.1 (27.3) | 64.9 (29.4) | 50.4 (31.7) | 64.9 (30.4) | 66.9 (26.2) |

| | | | | | |
|---|---|---|---|---|---|
| Prior anxiety | | | | | |
| Never | 36.1 (27.5) | 40.3 (32.6) | 30.5 (30.0) | 50.5 (32.5) | 29.9 (30.9) |
| Sometimes | 43.0 (27.7) | 50.7 (33.4) | 41.2 (32.4) | 59.6 (32.2) | 44.0 (33.7) |
| Very often | 42.3 (25.4) | 47.2 (32.3) | 43.6 (31.1) | 63.1 (31.1) | 48.9 (32.4) |
| Every day | 54.4 (31.1) | 71.6 (32.9) | 60.2 (30.3) | 71.3 (31.1) | 59.7 (32.5) |
| Prior anger | | | | | |
| Never | 36.3 (36.3) | 40.5 (32.6) | 31.0 (30.2) | 50.7 (32.4) | 30.0 (30.8) |
| Sometimes | 39.6 (28.2) | 46.4 (33.2) | 36.2 (31.5) | 56.2 (33.2) | 39.1 (33.5) |
| Very often | 53.9 (26.3) | 56.4 (34.2) | 47.7 (33.0) | 69.6 (28.7) | 56.4 (31.1) |
| Every day | 52.3 (40.3) | 70.2 (32.4) | 58.8 (35.4) | 73.8 (31.5) | 69.5 (31.0) |
| Prior frustration | | | | | |
| Never | 36.0 (27.2) | 39.9 (32.5) | 30.5 (30.1) | 49.8 (32.4) | 29.4 (30.8) |
| Sometimes | 40.0 (28.3) | 46.7 (33.5) | 36.2 (31.6) | 57.0 (32.7) | 38.7 (32.8) |
| Very often | 42.0 (26.4) | 47.8 (33.4) | 40.3 (30.5) | 61.1 (31.9) | 43.5 (33.8) |
| Every day | 61.3 (30.8) | 73.2 (25.4) | 60.8 (33.3) | 82.0 (17.2) | 72.7 (24.0) |
| Prior fear | | | | | |
| Never | 36.8 (27.6) | 41.3 (32.8) | 31.4 (30.4) | 51.3 (32.6) | 31.2 (31.4) |
| Sometimes | 40.6 (26.8) | 48.0 (33.2) | 39.3 (31.3) | 59.3 (32.3) | 41.9 (33.2) |
| Very often | 49.1 (28.3) | 52.3 (33.2) | 53.9 (34.7) | 65.7 (30.2) | 54.8 (38.8) |
| Every day | 60.7 (32.1) | 74.3 (25.2) | 73.8 (15.1) | 82.9 (12.8) | 70.9 (26.1) |

* Pain related emotions were measured on a 100 mm visual analogue scale.

Table 12 Correlations between pain-related emotions at six weeks, and pain characteristics at baseline and at 6 weeks. Pain and emotions were assessed on a 100 mm VAS.

| | Six weeks emotions (Mean S.D) | | | | |
|---|---|---|---|---|---|
| Variables | Anxiety | Anger | Fear | Frustration | Depression |
| Initial neck pain | 0.37** | .035** | 0.31** | 0.36** | 0.32** |
| Initial headache pain | 0.30** | 0.32** | 0.28** | 0.30** | 0.30** |
| Initial other pain | 0.25** | 0.26** | 0.25** | 0.28** | 0.24** |
| Initial % body in pain | 0.20** | 0.21** | 0.20** | 0.25** | 0.22** |
| Neck pain at 6 weeks | 0.62** | 0.50** | 0.49** | 0.53** | 0.48** |
| Headache pain at 6 weeks | 0.47** | 0.43** | 0.42** | 0.44** | 0.44** |
| Other pain at 6 weeks | 0.41** | 0.38** | 0.40** | 0.40** | 0.36** |
| % body in pain at 6 weeks | 0.37** | 0.34** | 0.35** | 0.41** | 0.36** |

**. Correlation is significant at the 0.01 level (2-tailed).

## 5.4 Summary for description of pain-related emotions by prior emotion status

Table 13 suggests that with increasing frequency of prior emotions (from "never" to "everyday"), the mean intensity of pain-related emotions at 6 weeks increases. Table 13 also demonstrates that pain-related frustration was especially intense, and that prior frustration and prior fear were particularly associated with pain-related emotions at six weeks.

Table 13. Mean intensity (and standard deviations) of pain-related emotions at six weeks post-injury, stratified by frequency of pre-injury emotions. Pain-related emotions assessed on a 100 mm VAS.

| | Anxiety | Anger | Fear | Frustration | Depression |
|---|---|---|---|---|---|
| Prior depression | | | | | |
| Never | 36.4 (27.2) | 40.9 (32.5) | 31.2 (30.1) | 51.2 (32.4) | 30.1 (30.7) |
| Sometimes | 41.2 (28.8) | 47.6 (35.2) | 38.4 (32.7) | 56.5 (33.6) | 44.2 (34.8) |
| Very often | 48.1 (34.8) | 51.4 (35.3) | 44.0 (33.9) | 64.3 (33.1) | 49.2 (36.7) |
| Every day | 52.1 (27.3) | 64.9 (29.4) | 50.4 (31.7) | 64.9 (30.4) | 66.9 (26.2) |
| Prior anxiety | | | | | |
| Never | 36.1 (27.5) | 40.3 (32.6) | 30.5 (30.0) | 50.5 (32.5) | 29.9 (30.9) |
| Sometimes | 43.0 (27.7) | 50.7 (33.4) | 41.2 (32.4) | 59.6 (32.2) | 44.0 (33.7) |
| Very often | 42.3 (25.4) | 47.2 (32.3) | 43.6 (31.1) | 63.1 (31.1) | 48.9 (32.4) |
| Every day | 54.4 (31.1) | 71.6 (32.9) | 60.2 (30.3) | 71.3 (31.1) | 59.7 (32.5) |
| Prior anger | | | | | |
| Never | 36.3 (36.3) | 40.5 (32.6) | 31.0 (30.2) | 50.7 (32.4) | 30.0 (30.8) |
| Sometimes | 39.6 (28.2) | 46.4 (33.2) | 36.2 (31.5) | 56.2 (33.2) | 39.1 (33.5) |
| Very often | 53.9 (26.3) | 56.4 (34.2) | 47.7 (33.0) | 69.6 (28.7) | 56.4 (31.1) |

| | | | | | |
|---|---|---|---|---|---|
| Every day | 52.3 (40.3) | 70.2 (32.4) | 58.8 (35.4) | 73.8 (31.5) | 69.5 (31.0) |
| Prior frustration | | | | | |
| Never | 36.0 (27.2) | 39.9 (32.5) | 30.5 (30.1) | 49.8 (32.4) | 29.4 (30.8) |
| Sometimes | 40.0 (28.3) | 46.7 (33.5) | 36.2 (31.6) | 57.0 (32.7) | 38.7 (32.8) |
| Very often | 42.0 (26.4) | 47.8 (33.4) | 40.3 (30.5) | 61.1 (31.9) | 43.5 (33.8) |
| Every day | 61.3 (30.8) | 73.2 (25.4) | 60.8 (33.3) | 82.0 (17.2) | 72.7 (24.0) |
| Prior fear | | | | | |
| Never | 36.8 (27.6) | 41.3 (32.8) | 31.4 (30.4) | 51.3 (32.6) | 31.2 (31.4) |
| Sometimes | 40.6 (26.8) | 48.0 (33.2) | 39.3 (31.3) | 59.3 (32.3) | 41.9 (33.2) |
| Very often | 49.1 (28.3) | 52.3 (33.2) | 53.9 (34.7) | 65.7 (30.2) | 54.8 (38.8) |
| Every day | 60.7 (32.1) | 74.3 (25.2) | 73.8 (15.1) | 82.9 (12.8) | 70.9 (26.1) |

## 5.5 Multiple linear regression models

### 5.5.1 Checking assumptions

1. Linearity: Bar graphs showed linearity trend between outcome and independent variables.
2. Normality: normal Q-Q plots showed these five outcomes variables had normal distribution.
3. Multicollinearity: The correlation analysis showed a high correlation among the five prior emotions. The correlation coefficients ranged from 0.39 to 0.67 (Table 14). Since they were highly correlated, we decided to include only one emotion at a time when the outcome is the corresponding pain-related emotion at six weeks follow-up.

Table 14 Correlations between prior general health and emotional status before collision

| Variables | General Health | Depressed | Anxiety | Angry | Frustrated | Fearful |
|---|---|---|---|---|---|---|
| General Health | 1.000 | 0.223* | 0.204* | 0.123* | 0.173* | 0.143* |
| Depressed | 0.223* | 1.000 | 0.467* | 0.403* | 0.444* | 0.389* |
| Anxiety | 0.204* | 0.467* | 1.000 | 0.409* | 0.443* | 0.431* |
| Angry | 0.123* | 0.403* | 0.409* | 1.000 | 0.671* | 0.433* |
| Frustrated | 0.173* | 0.444* | 0.443* | 0.671* | 1.000 | 0.463* |
| Fearful | 0.143* | 0.389* | 0.431* | 0.433* | 0.463* | 1.000 |

**. Correlation is significant at the 0.01 level (2-tailed).

### 5.5.2 Results of the multiple linear regression

Tables 15 to 19 show the univariate and multivariable β and their 95% confidence intervals for the associations between pain-related emotions (anxiety, anger, frustration, fearfulness and depression) at six weeks after collision and their important associated factors.

1. The final regression model for post-injury pain-related anxiety showed combined family income, employment status, anger before collision, general health before collision, lawyer involvement, ringing in ears after collision, initial neck/shoulder pain, initial headache, and initial other pain were associated with post injury pain-related anxiety. Although important in the crude analysis, baseline age, gender, Body Mass Index, education, initial health care provider, being off work due

to accident, dizziness or unsteadiness, vision problems and percentage of body in pain were not found to be important in the final multivariate model.

We found that low income (less than $20,000) was strongly associated with pain-related anxiety at six week after the injury. Compared to those working full-time, people who worked part-time and those who identified themselves as homemakers suffered less pain-related anxiety than those who worked full-time. Important associations between prior anxiety and pain- related anxiety after the collision were observed only for people who reported being anxious "sometimes" before the injury. Also, individuals who rated themselves as being in "fair" or "poor" general health before the collision were more likely to experience pain-related anxiety than those who reported themselves as being in "excellent" health. Lawyer involvement was strongly associated with post-injury, pain-related anxiety. Subjects who reported ringing in their ears after the collision were much more likely to experience pain-related anxiety after the initial injury. Moreover, the associations between pain-related anxiety at six weeks and initial neck/shoulder, headache other pain were especially strong. In detail, when initial VAS neck/shoulder pain increased one mm, people's pain-related anxiety increased by 0.26 VAS mm.

Table 15 Factors associated with pain-related anxiety.

| variables | Univariate β (95% CI) | Multivariable β (95% CI) |
|---|---|---|
| Age | -0.09 (-0.16 – -0.01) | -0.02 (-0.12 – 0.08) |
| Gender | 0.10 (-2.20 – 2.41) | 0.16 (-2.13 – 2.45) |
| Body mass index | 0.25 (0.03 – 0.46) | 0.20 (-0.00 – 0.41) |
| Education | | |
| Grade 8 or less | 0 | 0 |
| Higher than grade 8, did not graduate | 0.01 (-6.02 – 5.99) | 2.17 (-3.70 – 8.04) |
| High school graduate | -2.76 (-8.56 – 3.03) | 1.27 (-4.61 – 7.15) |
| Post-secondary or some university | -6.73 (-12.40 – -1.06) | -1.96 (-7.78 – 3.87) |
| University graduate | -14.04 (-20.27 – -7.81) | -5.70 (-12.02 – 0.63) |
| Combined family income | | |
| $0 -$20,000 | 0 | 0 |
| $20,001-$40,000 | -6.42 (-9.05 – -3.78) | -4.30 (-6.95 – -1.66) |
| $40,001-$60,000 | -8.24 (-11.23 – -5.24) | -5.15 (-8.21 – -2.10) |
| Above $60,000 | -10.51 (-14.10 – -6.92) | -5.20 (-8.90 – -1.50) |
| Employment status | | |
| Full time | 0 | 0 |
| Student | 1.39 (-2.67 - 5.44) | -2.44 (-6.54 – 1.67) |
| Part time | -1.43 (-4.28 – 1.42) | -3.41 (-6.15 – -0.68) |
| Homemaker | -0.14 (-3.99 – 3.70) | -4.49 (-8.43 – -0.54) |
| Retired | 0.33 (-4.82 – 5.47) | 1.91 (-3.97 – 7.78) |
| Unemployed | 4.57 (-0.16 – 9.29) | -2.60 (-7.35 – 2.15) |
| General health before accident | | |
| Excellent | 0 | 0 |
| Very good | 1.44 (-1.05 – 3.93) | 0.94 (-1.40 – 3.27) |
| Good | 3.52 (0.58 – 6.45) | 1.67 (-1.26 – 4.59) |
| Fair or Poor | 13.03 (7.70 – 18.37) | 5.89 (0.52 – 11.25) |
| Anxiety before accident | | |
| Never | 0 | 0 |
| Sometimes | 6.87 (3.73 – 10.01) | 4.48 (1.50 – 7.45) |
| Very often or Every day | 8.86 (2.01 – 15.70) | 3.19 (-3.45 – 9.82) |
| Lawyer involvement | | |
| No | 0 | |
| Yes | 13.38 (8.97 – 17.79) | 6.97 (2.73 – 11.21) |
| Provider | | |
| None | 0 | 0 |
| MD | 5.00 (-1.57 – 11.57) | 0.08 (-5.92 – 6.09) |
| DC | -7.25 (-14.87 – 0.36) | -4.55 (-11.52 – 2.42) |
| MD and DC | 3.96 (-3.13 – 11.05) | -2.00 (-8.51 – 4.51) |

| | | |
|---|---|---|
| MD and PT | 9.80 (2.57 – 17.02) | 4.45 (-2.16 – 11.05) |
| Off work due to accident | | |
| No | 0 | 0 |
| Yes | 3.99 (1.82 – 6.15) | -0.05 (-2.35 – 2.25) |
| Dizziness or unsteadiness | | |
| No | 0 | 0 |
| Yes | 8.20 (6.05 – 10.35) | 0.97 (-1.26 – 3.18) |
| Ringing in ears | | |
| No | 0 | 0 |
| Yes | 10.64 (7.94 – 13.33) | 3.91 (1.22 – 6.6) |
| Vision problem | | |
| No | 0 | 0 |
| Yes | 11.60 (8.34 – 14.87) | 1.91 (-1.34 – 5.15) |
| Initial neck/shoulder pain (VAS) | 0.43 (0.38 – 0.47) | 0.26 (0.21 – 0.31) |
| Initial headache pain (VAS) | 0.26 (0.23 – 0.29) | 0.09 (0.06 – 0.13) |
| Initial other pain (VAS) | 0.21 (0.18 – 0.24) | 0.10 (0.06 – 0.13) |
| % body in pain (VAS) | 0.37 (0.29 – 0.44) | 0.06 (-0.03 – 0.14) |

2. The final regression model for post injury, pain-related anger includes baseline age, education, combined family income, employment status, anger before accident, general health before accident, lawyer involvement, dizziness or unsteadiness, ringing in ears after collision, initial neck/shoulder, headache, and other pains. Gender, being off work due to accident, vision problem and % body in pain were not important in the domain specific models, and were not included in the final model.

Regression showed that older people were less likely to experience pain-related anger than younger ones. When age increased by one year, the VAS pain-related anger decreased by 0.24 mm. An important association was only noted among subjects who reporter having education above the Grade 8 level but who did not graduate from high school. Those people were more likely to have pain-related anger than those who reported having less than a Grade 8 education.

Combined family incomeof $20,000 -$60,000 was found to be highly associated with less anger at six week follow-up than low combined family income (< $20,000). "Fair" or "poor" general health prior to injury was associated with pain-related anger.. Moreover, the association with prior anger and lawyer involvement was especially strong.

People with who reported dizziness or unsteadiness or ringing in the ears after collision were much more likely to experience pain-related anger later on. Also, we found strong associations between initial neck/shoulder, headache and other pain and pain-related anger after traffic injury. When initial VAS neck/shoulder pain increased one by mm, people's pain-related anger increased by 0.25 mm.

Although it was weak, we noted an association between participants' employment status and pain-related anger. Compared to those working full-time, people who worked part-time were less likely to become angry six weeks after collision.

Table 16 Factors associated with pain-related anger.

| variables | Univariate β (95% CI) | Multivariable β (95% CI) |
|---|---|---|
| Age | -0.38 (-0.46 – -0.29) | -0.24 (-0.36 – -0.13) |
| Gender | 1.52 (-1.21 – 4.24) | 1.26 (-1.40 – 3.91) |
| Education | | |
| Grade 8 or less | 0 | 0 |
| Higher than grade 8, did not graduate | 10.32 (3.06 – 17.48) | 9.19 (2.33 – 16.06) |
| High school graduate | 7.32 (0.41 – 14.23) | 5.88 (-1.02 – 12.76) |
| Post-secondary or some university | 3.31 (-3.46 – 10.07) | 1.93 (-4.89 – 8.75) |
| University graduate | -6.51 (-13.94 – 0.92) | -2.22 (-9.63 – 5.18) |
| Combined family income | | |
| $0 -$20,000 | 0 | 0 |
| $20,001-$40,000 | -9.38 (-12.48 – -6.27) | -5.32 (-8.40 – -2.25) |
| $40,001-$60,000 | -13.11 (-16.64 – -9.57) | -7.41 (-10.95 – -3.87) |
| Above $60,000 | -12.16 (-16.41 – -7.90) | -3.54 (-7.85 – 0.77) |
| Employment status | | |
| Full time | 0 | 0 |
| Student | 4.28 (-0.52 – 9.07) | -1.28 (-6.03 – 3.48) |
| Part time | -0.06 (-3.41 – 3.30) | -3.21 (-6.37 – -0.04) |
| Homemaker | -0.46 (-5.02 – 4.10) | -3.26 (-7.85 – 1.35) |
| Retired | -9.85 (-15.94 – -3.76) | 0.21 (-6.60 – 7.01) |
| Unemployed | 8.57 (3.01 – 14.14) | -0.06 (-5.56 – 5.46) |
| General health before accident | | |
| Excellent | 0 | 0 |
| Very good | 0.09 (-2.87 – 3.05) | 0.37 (-2.34 – 3.07) |
| Good | 0.79 (-2.70 – 4.27) | 1.51 (-1.87 – 4.88) |
| Fair or Poor | 13.95 (7.60 – 20.29) | 6.90 (0.81 – 12.99) |
| Anger before accident | | |
| Never | 0 | 0 |
| Sometimes | 5.92 (2.65 – 9.19) | 4.31 (1.31 – 7.30) |
| Very often or Every day | 18.47 (9.61 – 27.34) | 10.98 (2.84 – 19.11) |
| Lawyer involvement | | |
| No | | 0 |
| Yes | 17.83 (12.66 – 23.00) | 8.87 (4.02 – 13.73) |
| Off work due to accident | | |
| No | 0 | 0 |
| Yes | 6.26 (3.69 – 8.82) | 1.97 (-0.65 – 4.60) |

| | | |
|---|---|---|
| Dizziness or unsteadiness | | |
| No | 0 | 0 |
| Yes | 11.61 (9.07 – 14.15) | 3.09 (0.51 – 5.66) |
| Ringing in ears | | |
| No | 0 | 0 |
| Yes | 13.27 (10.09 – 16.44) | 5.46 (2.34 – 8.57) |
| Vision problem | | |
| No | | 0 |
| Yes | 12.49 (8.58 – 16.40) | 1.47 (-2.33 – 5.26) |
| Initial neck/shoulder pain (VAS) | 0.47 (0.42 – 0.53) | 0.25 (0.19 – 0.30) |
| Initial headache pain (VAS) | 0.32 (0.28 – 0.36) | 0.14 (0.09 – 0.18) |
| Initial other pain (VAS) | 0.25 (0.22 – 0.29) | 0.12 (0.08 – 0.16) |
| % body in pain (VAS) | 0.42 (0.33 – 0.50) | 0.02 (-0.07 – 0.12) |

3. The final regression model for post injury pain-related fearfulness contained the following factors: gender, education, combined family income, employment status, fearfulness before the collision, lawyer involvement, post-injury dizziness or unsteadiness, ringing in ears after collision, initial neck/shoulder, headache and other pains.

We found that people reporting more than $20,000 of combined annual family income were much less likely to be fearful than those who earned under $20,000. Compared to those who worked full-time outside the home, homemakers reported lower levels of fearfulness after the collision.

Prior fearfulness was strongly associated with pain-related fearfulness six weeks post-collision. Also, subjects with post-injury dizziness or unsteadiness were much more likely to suffer pain-related fearfulness after the collision. Furthermore, it appears that pain-related fearfulness after traffic injury was highly associated with initial neck/shoulder, headache, and other pain.

Some weak associations were discovered concerning gender, education, lawyer involvement and post-injury ringing in the ears. We noted that female

participants reported more pain-related fearfulness compared to males. Subjects who had a university degree were less likely to have pain-related fearfulness compared to those with Grade 8 education or less. Lawyer involvement and post-injury ringing in the ears were found to be significantly associated with post-injury, pain-related fearfulness, although the effect size was small.

Table 17 Factors associated with pain-related fear.

| variables | Univariate β (95% CI) | Multivariable β (95% CI) |
|---|---|---|
| Age | -0.19 (-0.27 - -0.10) | -0.10 (-0.21 – 0.01) |
| Gender | 2.60 (0.06 – 5.14) | 2.75 (0.11 – 5.39) |
| Education | | |
| Grade 8 or less | 0 | 0 |
| Higher than grade 8, did not graduate | 3.44 (-3.19 – 10.06) | 1.90 (-4.76 – 8.56) |
| High school graduate | 1.20 (-5.19 – 7.60) | -1.64 (-8.33 – 5.04) |
| Post-secondary or some university | -2.66 (-8.91 – 3.60) | -4.34 (-10.95 – 2.27) |
| University graduate | -9.91 (-16.79 - -3.02) | -7.31 (-14.49 - -0.13) |
| Combined family income | | |
| $0 -$20,000 | 0 | 0 |
| $20,001-$40,000 | -7.18 (-10.08 - -4.28) | -4.04 (-7.09 - -0.99) |
| $40,001-$60,000 | -10.43 (-13.73 - -7.13) | -5.57 (-9.07 - -2.08) |
| Above $60,000 | -11.07 (-15.04 - -7.09) | -4.77 (-9.07 - -0.47) |
| Employment status | | |
| Full time | 0 | 0 |
| Student | 3.25 (-1.24 – 7.74) | -1.24 (-5.82 – 3.35) |
| Part time | -0.26 (-3.39 – 2.87) | -2.75 (-5.87 – 0.37) |
| Homemaker | -1.99 (-6.22 – 2.25) | -7.48 (-11.87 - -3.10) |
| Retired | -3.58 (-9.26 – 2.09) | 0.61 (-5.83 – 7.05) |
| Unemployed | 7.51 (2.31 – 12.71) | 1.26 (-4.13 – 6.65) |
| General health before accident | | |
| Excellent | 0 | 0 |
| Very good | 0.87 (-1.88 – 3.62) | 0.16 (-2.52 – 2.84) |
| Good | 3.18 (-0.06 – 6.43) | 2.46 (-0.90 – 5.82) |
| Fair or Poor | 13.78 (7.90 – 19.66) | 4.77 (-1.40 – 10.93) |
| Fearfulness before accident | | |
| Never | 0 | 0 |
| Sometimes | 7.94 (3.40 – 12.47) | 6.62 (2.12 – 11.12) |
| Very often or Every day | 30.43 (19.46 – 41.39) | 21.39 (10.79 – 31.98) |

| | | |
|---|---|---|
| Injury to the neck/shoulder in past | | |
| No | 0 | 0 |
| Yes | 4.16 (1.44 – 6.88) | 0.74 (-1.87 – 3.34) |
| Lawyer involvement | | |
| No | 0 | 0 |
| Yes | 14.14 (9.27 – 19.01) | 5.04 (0.22 – 9.86) |
| Provider | | |
| None | 0 | 0 |
| MD | 2.26 (-5.10 – 9.61) | -3.18 (-10.34 – 3.99) |
| DC | -10.35 (-18.87 - -1.83) | -8.20 (-16.47 – 0.08) |
| MD and DC | 2.68 (-5.25 – 10.61) | -4.01 (-11.73 – 3.71) |
| MD and PT | 4.43 (-3.64 – 12.51) | -0.91 (-8.72 – 6.91) |
| Dizziness or unsteadiness | | |
| No | 0 | 0 |
| Yes | 11.16 (8.80 – 13.52) | 3.90 (1.36 – 6.44) |
| Ringing in ears | | |
| No | 0 | 0 |
| Yes | 9.65 (6.67 – 12.62) | 3.18 (0.11 – 6.26) |
| Vision problem | | |
| No | 0 | 0 |
| Yes | 12.33 (8.70 – 15.96) | 1.24 (-2.49 – 4.97) |
| Initial neck/shoulder pain (VAS) | 0.38 (0.33 – 0.43) | 0.18 (0.12 – 0.24) |
| Initial headache pain (VAS) | 0.26 (0.22 – 0.29) | 0.12 (0.08 – 0.17) |
| Initial other pain (VAS) | 0.23 (0.20 – 0.26) | 0.11 (0.07 – 0.15) |
| % body in pain (VAS) | 0.39 (0.31 – 0.47) | 0.05 (-0.04 – 0.15) |

4. The final regression model for post-injury, pain-related frustration involves 13 factors: baseline age, education, combined family income, employment status, frustration before accident, general health before accident, lawyer involvement, post-injury dizziness or unsteadiness, ringing in ears after collision, initial neck/shoulder, headache, other pains and % body in pain..

We found that older people experienced less pain-related frustration than younger ones six weeks after traffic collision. When age increased by one year, the VAS pain-related frustration decreased by 0.17 mm.

Subjects who had an education higher than Grade 8 but who did not graduate were more likely to report pain-related frustration than those who had Grade 8 or less. Combined annual family income of $40,000-$60,000 was associated with pain-

related frustration; an association was not observed among lower-income participants (less than $20,000). An important association existed between employment status and pain-related frustration. Individuals who worked part-time reported lower levels of frustration after collision than those who worked full time.

Experiencing frustration prior to injury was highly associated with pain-related frustration six weeks after the collision. Moreover, subjects who reported "fair" or "poor" general health before the accident were more likely to report pain-related frustration than those who reported being in "excellent" health. Lawyer involvement was strongly associated with post-injury, pain-related frustration. Post-injury dizziness or unsteadiness or ringing in the ears was significantly associated with pain-related frustration after accident. Furthermore, the associations between pain-related frustration and initial neck/shoulder, headache, other pain, and % body in pain were especially strong. In detail, when initial VAS neck/shoulder pain increased by one mm, people's pain-related frustration increased by 0.27 mm.

Table 18 Factors associated with pain-related frustration.

| variables | Univariate β (95% CI) | Multivariable β (95% CI) |
|---|---|---|
| Age | -0.31 (-0.40 - -0.23) | -0.17 (-0.28 - -0.05) |
| Gender | 2.73 (0.03 – 5.43) | 1.93 (-0.72 – 4.58) |
| Education | | |
| Grade 8 or less | 0 | 0 |
| Higher than grade 8, did not graduate | 10.24 (3.17 – 17.31) | 8.22 (1.43 – 15.01) |
| High school graduate | 8.52 (1.71 – 15.34) | 6.73 (-0.09 – 13.54) |
| Post-secondary or some university | 6.21 (-0.46 – 12.88) | 4.38 (-2.36 – 11.13) |
| University graduate | -1.73 (-9.08 – 5.61) | 1.16 (-6.17 – 8.48) |
| Combined family income | | |
| $0 -$20,000 | 0 | 0 |
| $20,001-$40,000 | -6.38 (-9.47 - -3.28) | -2.43 (-5.48 – 0.64) |
| $40,001-$60,000 | -8.92 (-12.44 - -5.40) | -3.73 (-7.25 - -0.21) |
| Above $60,000 | -10.48 (-14.73 - -6.24) | -2.99 (-7.29 – 1.31) |
| Employment status | | |

| | | |
|---|---|---|
| Full time | 0 | 0 |
| Student | 1.92 (-2.84 – 6.67) | -2.14 (-6.88 – 2.60) |
| Part time | -1.29 (-4.61 – 2.03) | -4.14 (-7.29 - -0.99) |
| Homemaker | -1.04 (-5.54 – 3.46) | -3.74 (-8.32 – 0.83) |
| Retired | -11.35 (-17.38 - -5.38) | -1.91 (-8.70 – 4.87) |
| Unemployed | 8.31 (2.78 – 13.84) | 2.22 (-3.28 – 7.72) |
| General health before accident | | |
| Excellent | 0 | 0 |
| Very good | 2.36 (-0.57 – 5.29) | 2.07 (-0.63 – 4.77) |
| Good | 2.25 (-1.20 – 5.70) | 2.72 (-0.64 – 6.08) |
| Fair or Poor | 14.28 (8.04 – 20.52) | 7.64 (1.56 – 13.72) |
| Frustration before accident | | |
| Never | 0 | 0 |
| Sometimes | 7.13 (4.17 – 10.09) | 4.97 (2.23 – 7.70) |
| Very often or Every day | 15.69 (8.83 – 22.56) | 9.40 (2.90 – 15.90) |
| Lawyer involvement | | |
| No | 0 | 0 |
| Yes | 16.7 (11.54 – 21.86) | 7.83 (2.96 – 12.69) |
| Off work due to accident | | |
| No | 0 | 0 |
| Yes | 6.62 (4.08 – 9.17) | 2.30 (-0.31 – 4.92) |
| Dizziness or unsteadiness | | |
| No | 0 | 0 |
| Yes | 12.01 (9.50 – 14.53) | 3.36 (0.80 – 5.93) |
| Ringing in ears | | |
| No | 0 | 0 |
| Yes | 12.36 (9.21 – 15.51) | 3.99 (0.89 – 7.09) |
| Vision problem | | |
| No | 0 | 0 |
| Yes | 11.87 (8.00 – 15.75) | 0.62 (-3.16 – 4.40) |
| Initial neck/shoulder pain (VAS) | 0.48 (0.43 – 0.53) | 0.27 (0.21 – 0.33) |
| Initial headache pain (VAS) | 0.30 (0.26 – 0.33) | 0.11 (0.07 – 0.15) |
| Initial other pain (VAS) | 0.27 (0.12 – 0.31) | 0.13 (0.09 – 0.17) |
| % body in pain (VAS) | 0.50 (0.41 – 0.58) | 0.11 (0.01 – 0.20) |

5. Pain-related depression at six-week follow-up (Table 19)

The final regression model for post-injury, pain-related depression encompasses: education, combined annual family income, employment status, depression before collision, self-reported prior general health, lawyer involvement, post-injury dizziness or unsteadiness, ringing in ears after collision, initial neck/shoulder, headache, other pains and % body in pain.

We noted that subjects who had a post-secondary education (or higher) were less likely to feel pain-related depressed than those with a Grade 8 education (or under). Combined annual family income greater than $20,000 was strongly associated with pain-related depression six weeks after traffic injury. Also, significant associations were revealed between employment status and pain-related depression. Part-time workers and homemakers were less likely to report be depressed after being injured in a traffic collision than people who worked full-time outside the home.

Feeling depressed "sometimes," "very often," or "every day" before their injury was strongly associated with pain-related depression six week after the collision. Also, subjects who reported being in "good," "fair" or "poor" general health prior to their injury were more likely to experience pain-related depression compared to those who said their prior health was "excellent."

Lawyer involvement was found to be moderately associated with post-injury, pain-related depression. There were strong associations between depression and dizziness, unsteadiness and/or ringing in the ears after the collision. Pain-related depression was especially strongly associated with initial neck/shoulder, headache, other pain, and % body in pain. When initial VAS neck/shoulder pain increased by one mm, pain-related depression increased by 0.21 mm.

Surprisingly, no associations were found between gender and pain-related depression six weeks after injury.

Table 19 Factors associated with pain-related depression.

| variables | Univariate β (95% CI) | Multivariable β (95% CI) |
|---|---|---|
| Age | -0.15 (-0.24 - -0.07) | -0.07 (-0.18 – 0.04) |
| Gender | 2.16 (-0.47 – 4.79) | 1.75 (-0.85 – 4.34) |
| Education | | |
| Grade 8 or less | 0 | 0 |
| Higher than grade 8, did not graduate | 0.78 (-6.12 – 7.68) | -0.64 (-7.23 – 5.95) |
| High school graduate | -3.99 (-10.64 – 2.67) | -4.58 (-11.19 – 2.03) |
| Post-secondary or some university | -6.34 (-12.86 – 0.17) | -6.56 (-13.09 - -0.02) |
| University graduate | -14.36 (-21.52 - -7.20) | -10.22 (-17.30 - -3.13) |
| Combined family income | | |
| $0 -$20,000 | 0 | 0 |
| $20,001-$40,000 | -8.82 (-11.82 - -5.83) | -5.15 (-8.14 - -2.15) |
| $40,001-$60,000 | -12.73 (-16.14 - -9.32) | -7.28 (-10.72 - -3.84) |
| Above $60,000 | -12.89 (-17.01 - -8.78) | -5.52 (-9.74 - -1.30) |
| Employment status | | |
| Full time | 0 | 0 |
| Student | 2.02 (-2.61 – 6.65) | -2.44 (-6.96 – 2.08) |
| Part time | -1.53(-4.76 – 1.71) | -4.29 (-7.38 - -1.21) |
| Homemaker | 0.04 (-4.35 – 4.43) | -6.16 (-10.48 - -1.83) |
| Retired | -2.50 (-8.42 – 3.42) | -0.80 (-7.19 – 5.59) |
| Unemployed | 13.08 (7.70 – 18.46) | 2.35 (-2.82 – 7.52) |
| General health before accident | | |
| Excellent | 0 | 0 |
| Very good | 2.97 (0.13 – 5.82) | 1.90 (-0.74 – 4.53) |
| Good | 6.59 (3.23 – 9.94) | 3.96 (0.67 – 7.25) |
| Fair or Poor | 18.66 (12.59 – 24.74) | 6.36 (0.38 – 12.34) |
| Depression before accident | | |
| Never | 0 | 0 |
| Sometimes | 14.10 (10.32 – 17.89) | 12.07 (8.50 – 15.65) |
| Very often or Every day | 24.77 (16.23 – 33.30) | 16.70 (8.67 – 24.73) |
| Lawyer involvement | | |
| No | 0 | 0 |
| Yes | 14.57 (9.53 – 19.60) | 5.07 (0.33 – 9.82) |
| Dizziness or unsteadiness | | |
| No | 0 | 0 |
| Yes | 13.36 (10.92 – 15.79) | 4.82 (2.33 – 7.31) |

| | | |
|---|---|---|
| Ringing in ears | | |
| No | 0 | 0 |
| Yes | 13.15 (10.08 – 16.22) | 4.58 (1.54 – 7.61) |
| Vision problem | | |
| No | 0 | 0 |
| Yes | 14.13 (10.36 – 17.90) | 2.37 (-1.34 – 6.08) |
| Initial neck/shoulder pain (VAS) | 0.42 (0.37 – 0.47) | 0.21 (0.15 – 0.26) |
| Initial headache pain (VAS) | 0.29 (0.25 – 0.33) | 0.12 (0.08 – 0.16) |
| Initial other pain (VAS) | 0.23 (0.19 – 0.26) | 0.09 (0.05 – 0.13) |
| % body in pain (VAS) | 0.44 (0.36 – 0.53) | 0.11 (0.01 – 0.20) |

### 5.5.3 Regression Diagnostics

Histograms, box plots, normal Q-Q plots and detrended normal Q-Q plots for each pain-related emotion at six weeks follow-up showed that residuals were normally distributed and had constant variance. Scatterplots indicated that there were not many outliers and influential observations. Therefore, the linear regression assumptions were confirmed by verifying normality of the distribution of residuals.

# Chapter 6 Discussion

Our results suggested that among the five pain-related emotions measured at six weeks after collision, frustration was the most predominant (was rated as the highest mean intensity), followed by pain-related anger. Surprisingly, pain-related depression and anxiety were rated as less intense. However, it should be noted that participants were not asked to directly compare these emotions, and so the relative importance of these emotions to injured persons can be speculative, only. Also, we noted that women had significantly higher means of both pain-related frustration and fear (than men) six weeks after traffic collision. Age was found to be negatively associated with pain-related anger and frustration. Education was a predictor of pain-related anger, frustration, fearfulness and depression, but not of anxiety. Combined annual family income was strongly associated with all five pain-related emotions at six weeks after traffic injury. Prior general health and prior emotions, lawyer involvement, dizziness or unsteadiness or ringing in ears were especially strong related to each of the pain-related emotions six weeks after whiplash injury. Pain is a common source of psychological distress, and we found that initial neck pain intensity and initial headache were important prognostic factosr for each of these five pain-related emotions at six weeks follow-up.

**Most intense emotion: pain-related frustration**

Compared with depression and anxiety, emotions such as anger, fear, and frustration have attracted far less attention from researchers and health care professionals for the purpose of psychological consultation or treatments (Fernandez and Turk, 1995; Wade et al., 1990). Prior studies of traffic injuries have reported that depression and anxiety were the most common type of emotional distress (Michaels et al., 1999; Mayou et al., 1993; Mayou et al., 2001).

Surprisingly, we found that pain-related frustration (followed by anger), not depression and anxiety, had the highest mean scores on the visual analogue scale six weeks after whiplash injury. To our knowledge, only a few other studies have identified these emotions as important in pain conditions. A cross-sectional study of acute back pain found that the predominant emotion was frustration rather than anxiety or depression (Philips and Grant, 1991). In another study, frustration (followed by anxiety) was found to be most highly related to pain (Riley et al, 2001). It was suggested that in both sexes, frustration and anxiety (measured by VAS) were the emotions most highly related to pain. In a study conducted by Adshead (2000), persistent fear was reported as a key aspect of posttraumatic stress disorder. Wade et al. (1990) measured depression, anxiety, anger, frustration and fear on visual analog scales and assessed their relationship to VAS measures of pain-related unpleasantness. They found frustration was a significant predictor of all three levels of pain unpleasantness; anger also contributed to the suffering of chronic pain. The results also suggested that anger and frustration are critical concomitants of the pain experience. Treatment techniques specifically targeting anger and frustration in these patients may prove efficacious (Wade et al., 1990).

**Demographic and socioeconomic predictive factors**

Generally, it is believed that women manifest greater negative pain-related mood in pain experiences than men (Bolton, 1994; Gilbar et al., 1998; Lacroix and Barbaree, 1990; Unruh, 1996). There are several possible interpretations for the mechanism underlying sex-related difference in the relationship between pain and emotion. For example, negative mood might cause greater disruption in the lives of women. However, in our study, sex differences were only present in frustration and fear, but not in other three emotions. The same result was noted by Riley et al in 2001. Surprisingly, we did not observe sex differences in pain-related depression and anxiety, which is contrary to the study by Keogh et al. (2006). In our study, older age was found to be negatively associated with pain-related anger and frustration, but not with depression, anxiety and fearfulness. Similar findings were observed by

Berglund et al. (2006). In our study, education and combined annual family income were found to be important predictors to pain-related emotions after traffic injury, although Berglund et al. (2006) concluded the opposite. In the literature, socioeconomic status has seldom been included when studying the prognosis of whiplash injury, and there is no consistent evidence regarding the importance of these factors (Côté et al., 2001 and Scholten-Peeters et al., 2003).

**Crash-related predictive factors**

We noted that legal issues may increase morbidity following whiplash injury. Lawyer involvement in our study was found to be strongly associated with pain-related emotions after whiplash injury. Not surprisingly, this finding is consistent with other studies (Dufton et al., 2006; Busse et al., 2004; Gun et al., 2005). The direction of the relationship is unclear, however, and it could be that consulting a lawyer increases claimants' psychological distress. Alternatively, however, it could be that those who are more psychologically distressed are more likely to seek legal counsel.

The problems of whiplash injury confront the otolaryngologists more frequently because the otological aspects of whiplash injuries. Dizziness and/or unsteadiness and tinnitus (ringing in ears) are common symptoms of chronic whiplash-associated disorders. Approximately 15-25% of WAD patients suffer from dizziness (Sterner and Gerdle, 2004). It has been reported that, after pain, dizziness and unsteadiness are the next most frequent complaints following whiplash injury, and are often associated with reports of loss of balance and falls (Rubin et al., 1995). Segal et al. observed that 55.4% of the whiplash injury victims reported tinnitus, and 0.8% had a conductive hearing loss (Segal et al., 2003). Although tinnitus is also an important annoying symptom in whiplash injury, few studies have investigated it among WAD symptoms. Ours is the first study to conclude that initial dizziness and/or unsteadiness and post-injury hearing problems are significant predictors of post collision emotional intensity.

### Initial pain

Pain is a common source of psychological distress. Not surprisingly, initial neck pain intensity and initial headache were important prognostic factors for these five pain-related emotions at six weeks follow-up in our study. Similar results were reported by Berglund et al. (2006).

### Pre-existing health conditions

Pre-existing health conditions have been found to be important factors in recovery from whiplash injury (Robertson and Katona, 1997; Mayou et al., 2001; Cassidy et al., 2000). Similarly, we found prior general health and emotional states before the collision were especially strongly associated with pain-related, post-collision emotions. Kivioja et al. (2004) reported that a history of psychiatric disease was more common in patients with chronic WAD. The dominant, retrospectively reported psychiatric diagnosis both before and after the accident was depression. Psychiatric morbidity may be a patient-related risk factor for chronic symptoms after a whiplash injury. The development of chronic symptoms after a whiplash injury seems to be associated with psychiatric vulnerability (Kivioja et al., 2004).

The current study has some important strengths. First, to our knowledge, this it is the first one to simultaneously investigate predictive factors for five pain-related emotions (anxiety, anger, frustration, fearfulness and depression). Individual emotions have been investigated in whiplash patients; however, we found no prior study that asked individuals with whiplash injuries to rate the intensity of this variety of pain-related emotions. Although we did not ask participants to directly compare (that is, to rank order) these emotions, our findings suggest that frustration and anger are of particular importance in the first few weeks following a whiplash injury.

Second, this study used VAS scoring methods to evaluate pain-related emotions as outcomes after whiplash injury. One of the major challenges in studying

the epidemiology of emotions is to quantify their intensity. Most studies have applied a series of psychological evaluation instruments to evaluate emotions where it is impossible to compare them due to different scaling. VAS measurement allows us to measure the quantity (intensity) of psychological states. Further, we are able to treat emotions as continuous outcomes, which should lead to greater responsiveness to change. We noted that the VAS was an instrument with good validity, excellent reliability, moderate distribution-based responsiveness and good anchor-based responsiveness compared to multi-item questionnaires in measuring quality of life (de Boer et al., 2004).

Third, this study is a population-based cohort study, and a wide range of potential prognostic factors was measured. We captured all the claimants who either sought health care or claimed for insurance benefits because of a traffic injury that occurred between July 1, 1994, and December 31, 1995 in the province of Saskatchewan. However, the study did not include those who did not seek health care or fill out a traffic claim form, but their injuries were likely to be mild or unattended. The ranges of potential prognostic factors included demographic and socioeconomic characteristics, general health before accident, collision-related factors and initial pain intensity.

One potential important limitation is our 40% response rate at six weeks follow- up, which means attrition may have threatened the internal validity of our study. If the attrition is differential – that is, if the characteristics of our follow-up sample were different than those of the baseline population – then selection bias may be present. If not, the results of our study can be used to describe the status of pain-related emotions in patients with whiplash injury. In our study, the multiple logistic models suggested the predictive factors: sex, education, combined family income, neck or shoulder pain intensity, and lawyer involvement were associated with six weeks participation status (Table 1). The logistic model showed respondents and non-respondents differed on these baseline variables. Therefore, the attrition is

differential and selection bias is present. However, our study still provided important information regarding pain-related emotions after traffic collision in respondent population with whiplash injury.

Another possible bias, misclassification, may present. We used self-reported questionnaires to measure prior emotional states before accidents. Howerver, the accuracy of self-reported comorbid conditions has not been systematically evaluated. A recently published study evidenced that 80% had significant past axial pain history or serious comorbidities (psychological distress and drug and alcohol abuse) in their records not disclosed in the spine clinic evaluation (Carragee, 2007). This may have also have occurred in our study, and would explain the low rate of reported prior depression and other negative emotional states. For example, we observed that 83.8% of females and 88.4% of males reported that they had never felt depressed prior to the injury. Given that the prevalence of significant depressive symptomatology in the general population is 20%, it seems likely that this reflects under-reporting of this prior emotion. This misclassification may have affected the findings.

Prevalence-incidence bias may also be present. This sort of bias refers to the fact that the prevalent cases tend, on average, to have longer durations with the condition of interest, and, therefore, bias can result when characteristics observed in prevalent samples are generalized to incident cases. In our study, the participants who reported experiencing pain-related emotions at the six week follow-up may have been experiencing emotional distress before the collision (therefore, they were prevalent cases, rather than incident cases). If present, prevalence-incidence bias would have leaded us to overestimate the relationship between the prior emotional levels and pain-related emotions at six weeks follow-up.

Other possible limitation is our use of self-report measurement for these five emotions rather than the definition from DSM-IV; American Psychiatric Association 1994, which provides a guideline to diagnosing psychiatric disorders. However, since our study was intended to evaluate the emotional moods related to pain, instead

of attempting to identify psychiatric disorders, we believe that the assessment of pain-related emotions using the VAS served as a valid measurement for this purpose.

Besides selection bias and prevalence-incidence bias, other possible sources of bias may be present. Misclassification of the other prognostic factors included (behsides the prior health and emotional status factors) might have occurred. Measurements were, to a large extent, assessed using self-report questions or questionnaires, which may have variable degrees of validity. However, information at baseline was collected before the outcome occurred. Thus, potential misclassification would probably be non-differential (i.e., not related to outcome), and any errors introduced would therefore most likely lead towards the null value. Another possible source of systematic error is the fact that the outcomes and most of the prognostic factors were self-reported. If, for example, those participants who reported severe complaints initially were also more inclined to "over-report" their emotional intensity at follow-up, then the observed relationships would be overestimated. At present we have limited knowledge regarding this issue; however, in an epidemiological study of musculoskeletal disorders, rating behaviour was studied in individuals who rated both exposure and outcome. No evidence was provided for the existence of systematic high and low rating behaviour (that is, systematic under- or over-reporting) (Toomingas et al., 1997). Confounding is not a concern in this study, since we are not attempting to estimating the independent effect of a particular exposure on pain-related emotions, but are instead attempting to identify factors that may be associated with post-injury emotional states. However, there may be important predictors which were not measured.

Despite these limitations, the present study provides important information regarding pain-related emotions at six weeks after whiplash injury. These findings may help explain pain-related emotions after collision-related whiplash injury, and emphasize the importance of being aware of a broad spectrum of emotional reactions – not just depressed mood and anxiety. It will be important to assess the clinical

importance of these emotions, especially the under-studied emotions of frustration and anger. It will also be important to assess the role these emotional states play in recovery.

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