Summary
The term whiplash originally referred to a specific movement of the head due to a rear-end collision. Later the term was used to refer to the complex of symptoms itself. The main feature of whiplash is neck pain. There may be a wide variety of other symptoms accompanying the neck pain, but the presence of neck pain is usually considered necessary for the diagnosis of whiplash. The accident is still the prerequisite to the complaints but has become defined in ever broader terms.

In 1995 the Quebec Task Force introduced the term Whiplash Associated Disorder (WAD) to capture the wide variety of symptoms attributed to whiplash by that time. Other terms used in the literature are late or post-whiplash syndrome, which indicate symptoms after a whiplash accident or movement. Over recent decades chronic neck pain has become a common complaint after motor vehicle accidents.

Although the majority of patients show spontaneous recovery within the first few months of a traffic accident, in as many as 40 percent of cases, acute complaints lead to a chronic syndrome with neck pain often accompanied by cognitive complaints. To date no somatic injury has been identified that can explain the chronic symptoms, which are thereby generally identified as medically unexplained, and this has given rise to various views, studies and controversies regarding their possible somatic, psychological or psychosomatic nature.

In research on low back pain it is well established that psychological factors are related to chronic pain and disability. Given the fact that in chronic whiplash there is also chronic musculoskeletal pain related to the spine without identification of a somatic cause, it seems reasonable to assume that psychological parameters can play a role in the aetiology and course of persisting whiplash symptoms. Therefore, the major aim of the studies presented in this thesis was to explore the relationships between psychological determinants and the prognosis of whiplash symptoms, as well as the consequences of these complaints for work disability.

Traffic accident victims who had initiated compensation claim procedures for personal injury with a Dutch insurance company were asked to participate in the various studies. Participants were assessed at one, six and twelve months after their accident, using relevant questionnaires. The longitudinal data was used to analyse predictive characteristics and the temporal order of events. To keep the total number of questionnaires small, and thereby ensure a sufficient response, different samples were used for each study with the exception of the study on work disability (Chapter 2), in which the sample was formed by combining the other four.

Chapter 1 provides a general introduction and overview of possible psychological parameters involved in whiplash. It concludes with an outline of the thesis.


**Work disability**

Work disability is one of the major financial factors in liability claims relating to whiplash complaints. Furthermore, previous research has shown that sick leave and disability pension costs are much higher than the costs of acute medical care, demonstrating that these parameters are of paramount importance when evaluating the consequences of neck pain after motor vehicle accidents. However, the previous studies on work disability related to whiplash are very heterogeneous, mainly due to cultural diversity in the conceptualization of work disability and social security systems, and they are often limited in sample size and consequently show wide variability in results. To gain an insight into the consequences of whiplash complaints for work disability, a prospective cohort study, described in Chapter 2, was designed to investigate the relationship between whiplash, its symptoms and work-related factors in a group of 879 participants with neck pain after a motor vehicle accident. These participants were followed up after six and twelve months.

A total of 58.8 percent of the population with neck complaints in our sample was work-disabled after the accident. Age and concentration complaints were important independent predictors of long-lasting work disability, whereas no evidence emerged to indicate that the degree of manual labour (blue or white-collar work) or educational level was involved in persistent work disability. The results suggest that whiplash-induced work disability is a highly frequent condition that could benefit most from interventions related to recovery from cognitive complaints and less from physically related interventions.

**Coping style**

Coping can be defined as the way in which someone behaviourally, cognitively and emotionally adapts so as to manage external or internal stressors. The accident itself, as well as the pain afterwards, can be considered an external stressor and therefore as requiring coping efforts. Dysfunctional coping styles might lead to enhanced pain experience or catastrophic interpretations of symptoms, thereby contributing to a bad prognosis. To gain an insight into the role of coping style in the generation and maintenance of whiplash symptoms, the prospective cohort study described in Chapter 3 investigated the relationship between coping style and the course of physical and cognitive symptoms in a cohort of 363 participants with neck pain after a motor vehicle accident. Participants were followed up after six and twelve months. The coping styles were determined using the Utrecht Coping List. The duration of neck complaints was measured from the time of the accident and from the time of filling in the first questionnaire. Survival analysis was used to study the association between the duration of neck complaints and the explanatory variables. The duration of the neck complaints was found to be associated with gender, palliative reaction, and the seeking of social support, which was one of the defined coping styles.
Kinesiophobia

The fear-avoidance model was developed to provide an integrated model of risk factors known to be associated with chronic pain. Central to this model is the concept of fear of pain. An excessively negative orientation towards pain catastrophizing and fear of movement/(re)injury (kinesiophobia) are important in the aetiology of chronic symptoms. Dysfunctional coping styles could fuel anxiety and psychosomatic mechanisms. Anxiety related to avoidance, such as that found in kinesiophobia or fear of (re)injury could play an important role in prolonging whiplash symptoms, considering their apparent relevance to other chronic pain syndromes.

To gain an insight into the role of kinesiophobia in the course of whiplash symptoms, the prospective cohort study described in Chapter 4 investigated the predictive value of early kinesiophobia in relationship to the course of physical and cognitive symptoms in a cohort of 367 participants with neck pain after a motor vehicle accident. Kinesiophobia was assessed using the Tampa Scale of Kinesiophobia (TSK-DV). Follow-up questionnaires were administered, six and twelve months after the collision. Survival analysis was used to study the relationship between the duration of neck symptoms and kinesiophobia as well as physical and cognitive complaints.

In a regression model that did not include physical and cognitive complaints, kinesiophobia was found to be related to a longer duration of neck pain. However, when symptom-related information was entered into the model, the effect of kinesiophobia did not reach statistical significance.

It was therefore concluded that, although a higher score on the TSK-DV is associated with a longer duration of neck symptoms, information on early kinesiophobia does not improve the ability to predict the duration of neck pain after motor vehicle collisions. However, the results suggest that anxiety is associated with recovery from whiplash.

Post-traumatic stress symptoms

Importantly, neck complaints in whiplash are caused by an accident, or at least experienced after one. An accident is often a frightening or terrifying experience which can lead to anxiety. Post-traumatic stress disorder is a specific anxiety related to the experience of a life-threatening event. Post-whiplash syndrome and post-traumatic stress disorder are both relatively common conditions following traffic accidents. Post-traumatic stress disorder is known to have high psychiatric and medical comorbidity. Post-traumatic stress symptoms may give rise to increased anxiety and vigilance levels, thereby fuelling catastrophic, dysfunctional interpretations of acute neck pain. It could therefore be expected that the post-traumatic stress anxiety symptoms are related to the severity of somatic complaints and could play a role in the prognosis of neck pain after motor vehicle accidents.

To investigate this hypothesis a prospective cohort study of 240 participants with
neck pain after a motor vehicle accident was designed and presented in Chapter 5. The relationship between post-traumatic stress disorder (and its symptoms) and the severity and course of whiplash at one, six and twelve months was presented. The Self-Rating Scale for post-traumatic stress disorder (SRS-PTSD) was used to assess the post-traumatic stress symptoms.

Post-traumatic stress disorder was related to the presence and severity of concurrent post-whiplash syndrome. More specifically, the intensity of hyperarousal symptoms that were related to post-traumatic stress disorder at one month was found to have predictive validity for the persistence and severity of post-whiplash syndrome at six and twelve-months follow-up. The results therefore suggest that post-traumatic stress disorder hyperarousal symptoms have a detrimental influence on the recovery from and severity of whiplash complaints following car accidents.

Pain catastrophizing and causal illness beliefs

Pain catastrophizing refers to an exaggerated negative orientation towards actual or anticipated pain. It has been associated with heightened disability in chronic pain, independent of the level of actual physical impairment.

Causal illness beliefs can be defined as the patient’s ideas about the origin or cause of the symptoms or illness experienced. The causal beliefs of the patient seem very relevant in relation to the persistence of complaints when no organic cause has been identified. When patients are diagnosed with an illness they generally develop an organized pattern of beliefs about their condition. These illness perceptions or cognitive representations directly influence behaviour parameters and the emotional response. Causal beliefs lead to expectations regarding the course of complaints. Negative expectations could give rise to avoidant behaviour, leading to avoidance of movement and physical activity, ultimately leading to disuse and a heightened state of fear.

In the large body of research on whiplash its cultural dependence is often the subject of discussion. The fact that whiplash only seems to occur in a restricted number of countries and runs an apparently different course in various countries seems to imply that the cultural context is a major factor to be considered. However, the actual nature of that cultural context has never been subject to research. Causal illness beliefs are shaped by cultural factors. Beliefs and expectations regarding whiplash were found to vary profoundly across countries, thereby providing a cultural parameter relevant to the prognosis of muscular neck pain.

Chapter 6 describes a prospective cohort study of 140 participants with neck pain after a motor vehicle accident, and was designed to examine the role of pain catastrophizing and causal beliefs with regard to the severity and persistence of neck complaints after motor vehicle accidents. Individuals involved in traffic accidents were sent questionnaires
containing the Neck Disability Index (NDI), the Pain Catastrophizing Scale (PCS) and the Causal Beliefs Questionnaire-Whiplash (CBQ-W). Complaints were monitored using additional questionnaires administered six and twelve months after the accident.

The study found that pain catastrophizing and causal beliefs were related to the severity of concurrent whiplash symptoms. The severity of initial complaints was related to the severity and persistence of whiplash complaints. However, attributing initial neck complaints to whiplash was also found to predict the persistence of disability at six and twelve-months follow-up.

The results suggest that causal beliefs may play a major role in the perceived disability and course of neck complaints after motor vehicle accidents, whereas pain catastrophizing is predominantly related to concurrent disability. The current findings are consistent with the view that an early conviction that neck complaints are caused by the medico-cultural entity of ‘whiplash’ has a detrimental effect on the course of symptoms.

Finally, in Chapter 7 the results of the various studies are integrated and discussed. A summary of the main results and a general discussion of the findings is presented. A Causal Beliefs-Anxiety Model is proposed, combining the results in an integrated framework. In this model, causal beliefs play an important role because they are the main factor leading from neck pain to the conviction that the pain is caused by ‘whiplash’. They function as the gatekeeper, guarding the entrance to the chronic pain circle. This illness belief is moderated by culturally embedded beliefs. Once the belief is established, catastrophizing fuels the process, leading to anxiety and increased attention to and focus on the perceived symptoms. Eventually the process of focusing on perceived pain and anxiety results in central sensitization, which provides a theoretical explanation for unexplained chronic pain.

The chapter also discusses methodological issues. Although there is no apparent reason to suspect that the samples studied, in which participants were recruited on the basis of their liability claims, contained a bias towards patients whose complaints were more serious, the personal injury claim context should nevertheless be taken into account when interpreting or generalizing the findings.

Since the connotations regarding whiplash are highly culture-dependent, the extrapolation of culture-related results from one population to another should be undertaken with care. It could well be that causal beliefs regarding whiplash differ from one population or country to another. Furthermore, since the samples studied consisted mainly of participants who had not visited an emergency room, this aspect should be taken into account when comparing the results with other studies.

The results suggest that modifying symptom expectations regarding whiplash and altering the causal attribution of initial myogenic neck complaints are two possible therapeutic strategies. Altering symptom expectation is a cultural process that should
be employed at the population level, typically requiring educational campaigns and professional guidelines, whereas altering causal beliefs is an individual process that can be readily undertaken by developing a cognitive behavioural intervention aimed at modifying these specific causal convictions.

Because the present results are essentially correlational in nature, no clear conclusions can be drawn regarding the causal status of the variables studied. Controlled studies specifically aimed at causal beliefs and expectations may not only be of important clinical value but may also allow more definitive conclusions to be drawn regarding the causal role of specific psychological factors in the recovery from whiplash complaints.

Future research should use functional outcome parameters such as work disability. Furthermore, the finding – that the prognosis of neck complaints after a motor vehicle accident is related to the early causal belief that the symptoms are the results of whiplash – gives rise to several directions for future research. In addition, the proposed Causal Beliefs-Anxiety Model provides ample suggestions for future research looking for further evidence that can steer the development of future interventions and prevention programmes.