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Introduction

Research on the consequences and aetiological factors related to neck pain after motor vehicle accidents has proven to be a sensitive subject, often leading to polemical discussions. Nevertheless, considering the consequences of chronic post-traumatic neck pain and the relatively high incidence of long-lasting symptoms in the Netherlands, insight into factors related to the prognosis which provide clues for prevention and treatment are urgently needed.

Thus far there have been only a limited number of studies on whiplash carried out in the Netherlands. Moreover, most of the research involves studies with a relatively small number of participants. Furthermore, since there is evidence indicating that cultural factors play an important role in whiplash, it is very important to conduct research within the Dutch context to investigate whether the results from international studies can be extrapolated to the Dutch situation in a straightforward fashion, or whether specific domestic factors related to the prognoses and treatment of whiplash in the Netherlands need to be explored. Therefore, the first aim of the present studies was to provide insight into whiplash in the Netherlands and to study the relevant factors in the Dutch context.

In the Netherlands, in the last decade there seems to be a remarkable reduction in the number of whiplash cases being seen by first-line physicians, although there are no reliable epidemiological figures. Recently, a Dutch research programme was even halted because of an insufficient number of participants. However, this tendency has not been observed in liability claims. Whiplash continues to occur frequently and is responsible for a large part of the costs of liability claims. In the present studies participants were recruited on the basis of their liability claims. Recruiting patients through a liability insurer is rather unique, even from an international perspective, but it has nevertheless proved to be an effective way of recruiting a decent-sized group sizes. Recruiting patients on the basis of liability claims not only guarantees a relatively large number of potential participants but also provides the opportunity to investigate whiplash in a claim situation.

The present research represents a first attempt to test a series of particular hypotheses directly. In short, the present series of studies investigated the following issues. The first study investigated the relationship between whiplash and work disability. Second, the role of coping style in the course of neck complaints after motor vehicle accidents was studied. The third study investigated the association between kinesiophobia and recovery from whiplash. Subsequently, the relevance of post-traumatic stress disorder with regard to the prognosis of whiplash was studied. And finally, pain catastrophizing and the influence of causal illness beliefs on the prognosis of whiplash were investigated.
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General discussion

Whiplash and 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.\textsuperscript{3,4} 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.\textsuperscript{5-14}

Therefore, part of the present thesis was designed to investigate work disability in relation to whiplash in the Netherlands. The results presented in Chapter 2 show that work disability due to post-whiplash syndrome after a motor vehicle accident is a common problem. More than half the population with neck complaints which was studied was work-disabled after the accident. Fortunately, the vast majority recovered from their work disability in the first year. Nevertheless, a substantial number of the participants (12.6%) showed persistent work disability after one year.

Detailed analyses revealed that at one month, work disability is independently related to physical factors such as higher neck pain intensity and more restricted neck movements, together with the use of medication and complaints about concentration. At six months, neck pain intensity and complaints about concentration remain related to the concurrent work disability, whereas at one-year follow-up only the intensity of the complaints about concentration were consistent with the concurrent work disability.

With respect to the predictive value of the factors measured the results show that work disability after six months was independently related to higher age and more initial intense concentration and headache complaints. Of all the factors available one month after the accident, work disability after one year was independently related to higher age and more intense concentration complaints.

This pattern was similar for blue and white-collar workers. Although one might expect white-collar workers to be affected more by concentration problems, surprisingly the results show that prolonged work disability is related to concentration complaints independently of the degree of manual labour (blue or white-collar work) or level of concentration. In a similar vein, neither self-employment nor gender proved to be significant predictive factors related to work disability.

Thus it appears that apart from age, concentration problems constitute a general factor that is associated with a poor prognosis in terms of work disability. This does not imply that other factors may not be involved in the persistence of work disability due
to whiplash complaints (see below). In previous research the intensity of early neck pain was found to be a main factor related to recovery from complaints. However, in relation to work disability this was not the case; early neck pain intensity had no independent predictive value with regard to returning to work. It is generally accepted that cognitive complaints, including reported concentration difficulties, are due to pain interference. It could therefore be expected that a higher level of experienced pain would lead to more reported concentration difficulties. Apparently, concentration difficulties have more implications for work than the reported pain level. One explanation could be that work acts as a distraction from pain. However, when concentration problems make work more difficult, or nearly impossible, work can no longer lead to distraction from physical complaints, thereby possibly contributing to continued work disability.

Obviously it should be acknowledged that the present prognostic design does not allow for strong conclusions regarding causal mechanisms. Nonetheless, when it comes to interventions, the present results suggest that work disability could benefit most from interventions related to recovery from cognitive complaints and less from physically related interventions.

The results presented in Chapter 2 on whiplash and work disability provided an insight into the extent and reach of the consequences of prolonged symptoms. The remaining studies focused on the possible mechanisms contributing to the persistence of whiplash complaints. Knowledge of factors relevant to the prognosis can contribute to a theoretical explanation of the condition but may also contribute in terms of prevention and the development of interventions.

**Whiplash and coping**

Coping can be defined as the way in which someone behaviourally, cognitively and emotionally adapts so as to manage external or internal stressors. After an accident the victim has to cope with several aspects of the event. First of all the victim has to cope with a stressful, potentially life-threatening event. Accidents can lead to physical complaints or to temporary or long-term disability, all demanding adequate coping skills. People may have to cope with a fear that complaints may be prolonged, or even worsen. An active coping style is usually considered preferable, and improving active coping strategies is often advised as a main treatment goal. Dysfunctional coping styles could lead to enhanced pain experience or catastrophic interpretations of symptoms, thereby contributing to a bad prognosis.

However, empirical data supporting the validity of this assumption was lacking. Therefore, the study presented in Chapter 3 used a prospective approach to test the assertion that a passive or palliative coping style is related to a poor prognosis in whiplash, whereas a more active coping style is related to a more favourable course.
The results showed that two weeks after the accident there was no relationship between neck pain and a specific coping style. However, the prognostic results indicate that seeking social support and a less palliative style of coping are related to a shorter duration of neck complaints. Seeking social support is associated with an internal locus of control, meaning that outcomes are thought to be under one’s own control. Previous research has shown that patients who believe they can control their pain, who avoid catastrophizing about their condition and who believe they are not severely disabled appear to function better than those who do not. Such beliefs may mediate some of the relationships between pain severity and adjustment. This finding suggests that through this pathway there is a possible relationship with expectations and hence causal attribution.

Palliative behaviour is related to seeking distraction, avoiding thinking about the problem and trying to feel better by smoking, drinking or relaxing, and it is known to be positively correlated with feelings of fear and inadequacy. It is expected that this fear could originate in irrational expectations of incapacity and chronic complaints.

**Whiplash and kinesiophobia**

In relation to low back pain, clinical studies suggest that an excessively negative orientation toward pain catastrophizing and fear of movement/(re)injury (kinesiophobia) are important in the aetiology of chronic symptoms. In the fear-avoidance model, catastrophizing leads to pain-related fear, leading in turn to avoidance behaviour, including avoidance of movement and physical activity. In low back pain, fear-avoidance beliefs are identified as risk factors for chronic low back symptoms, suggesting that these factors are causal. Furthermore, patients with chronic low back pain who retrospectively reported a sudden traumatic pain onset exhibited higher kinesiophobia than patients who reported that the pain symptoms started gradually. In the case of whiplash the onset of pain is often sudden.

Because of the apparent role of kinesiophobia in the transition from acute to chronic low back pain, it is conceivable that it could play a role in recovery from acute neck pain as well. In line with this presumption the results of the one-year prospective study (Chapter 4) showed that kinesiophobia was indeed associated with the duration of neck pain. In accordance with earlier research on kinesiophobia in low back pain, which showed a modest but significant relationship between pain intensity and kinesiophobia, kinesiophobia was found to be significantly related to the intensity of neck pain. However, when the severity of the reported physical symptoms was taken into account it appeared that kinesiophobia had no independent relationship with the duration of neck pain after motor vehicle accidents. Kinesiophobia was found to be related to the perceived intensity of neck pain, which explains why its contribution to the duration of neck complaints
disappears when somatic complaints are added to the model. One possible explanation could be that in neck pain other, anxiety-related factors play a more prominent role than the rather specific fear of movement/(re)injury. The fact that neck pain starts or is attributed to an often stressful traffic accident clearly distinguishes it from most cases of low back pain and could give rise to more or different forms of anxiety. The sudden, traumatic onset could for instance give rise to stronger somatic beliefs and related fears regarding recovery. Furthermore, it is also conceivable that neck pain in itself is experienced as more frightening than low back pain, which is more common and usually known to be benign in nature. All in all, the results suggest that anxiety is associated with recovery from whiplash but kinesiophobia is not specifically related to the prognosis of post-traumatic neck pain.

**Whiplash and post-traumatic stress disorder**

Post-whiplash syndrome and post-traumatic stress disorder are both relatively common conditions following traffic accidents. As much as 23 percent of traffic accident victims are reported to have developed post-traumatic stress disorder, which is known to have high psychiatric and medical comorbidity. Therefore, it has been speculated that there is a relationship between post-traumatic stress disorder and whiplash.

In accordance with earlier research, and in line with the notion that post-traumatic stress disorder may intensify reported whiplash symptoms, the results presented in Chapter 5 show that post-traumatic stress disorder and its symptoms are more prevalent among car accident victims with post-whiplash syndrome. Perhaps even more importantly, the initial number of hyperarousal symptoms was found to have predictive validity for the persistence and severity of post-whiplash syndrome at six and twelve-months follow-up. This predictive validity cannot be readily attributed to either the severity of the accident or the severity of the sustained injury, as these aspects have been found to be largely independent of the development of post-traumatic stress disorder. This result seems to correspond with earlier research that suggests that victims with post-whiplash syndrome generally considered the accident more frightening than did other car accident victims.

Because perceived threat is of paramount importance in developing post-traumatic stress disorder, it can be speculated that the presence of whiplash complaints is threatening and induces anxiety complaints. This would make the accident more frightening and could subsequently lead to a relatively high number of post-traumatic stress complaints.

The relationship between post-whiplash complaints and post-traumatic stress symptoms was especially pronounced for the hyperarousal symptoms cluster. The mean number of hyperarousal symptoms was three to five times higher among participants with post-whiplash syndrome at one, six and twelve months after the accident. Because the hyperarousal symptom cluster closely resembles anxiety-disorder symptoms, this
finding may indicate that general anxiety symptoms have an important influence on the perceived severity of post-whiplash syndrome. It is conceivable that whiplash-related anxiety inflates both the hyperarousal symptoms as well as the experienced whiplash complaints, while vice versa, post-traumatic stress symptoms related to the sudden and traumatic origin of physical complaints could also inflate experienced symptoms and fuel whiplash-related anxiety. Hyperarousal symptoms also include hypervigilance, which is known to be correlated with higher reported pain intensity and catastrophic thinking. Accordingly, it could be that this results in symptom amplification, fuelling perceived symptom severity, thereby contributing to a process which leads to chronic complaints. One way to test this possibility is to conduct a prospective study of the predictive value of catastrophic thoughts. Such a study was presented in Chapter 6.

It is important to note that the post-traumatic stress disorder hyperarousal symptoms closely resemble complaints such as difficulty concentrating or nervousness, often attributed to post-whiplash syndrome. It is therefore conceivable that these often reported symptoms are actually related to post-traumatic stress. It is also possible that the predictive value of hyperarousal symptoms is due to the fact that these symptoms resemble symptoms associated with post-whiplash syndrome. The intensity of these symptoms is known to be related to the prognosis. The present pattern is consistent with the idea that at least some symptoms usually attributed to post-whiplash syndrome are actually post-traumatic stress symptoms. This further highlights the importance of considering post-traumatic stress disorder, particularly the hyperarousal symptoms, when evaluating post-whiplash symptoms.

**Pain catastrophizing in whiplash**

Earlier work in the context of chronic disorders characterized by unexplained physical complaints, such as chronic low back pain, has provided evidence to suggest that pain catastrophizing and attributional bias are of crucial importance in the development of chronic complaints. The research found that the habitual tendency to make catastrophic interpretations of pain is associated with a heightened pain experience in various patient groups. Furthermore, catastrophizing has been associated with heightened disability in chronic pain, independent of the level of actual physical impairment. The study presented in Chapter 5 revealed a relationship between hyperarousal symptoms and the prognosis of neck pain, which could indicate that hypervigilance, which is associated with catastrophizing, also plays a role.

The present results show that, consistent with research into chronic pain, pain catastrophizing is related to concurrent neck disability. It is feasible that catastrophizing leads to increased physical complaints thereby indirectly contributing to a delayed recovery. However, the results indicate that pain catastrophizing has no independent
predictive value.

**Causal beliefs**

Causal illness beliefs are defined as the ideas the patient has regarding the cause or origin of the symptoms or illness experienced. In relation to chronic fatigue syndrome it has been found that somatic illness beliefs are associated with increased symptoms and functional impairment, poorer subjective and objective outcomes and poor prognosis. In a similar vein, dysfunctional causal beliefs may also apply to myogenic neck complaints after motor vehicle accidents. Dysfunctional causal beliefs can be defined as the attribution of the cause of acute myogenic neck complaints to severe, neural or irreparable causes. At the chronic stage of post-whiplash syndrome, somatic or organic beliefs in general can be considered dysfunctional. Causal beliefs are assumed to fuel anxiety regarding the origin and expected course of whiplash symptoms.

To test the role of causal illness beliefs in the persistence of post-whiplash syndrome the Causal Beliefs Questionnaire-Whiplash (CBQ-W) was developed. This CBQ-W is based on clinical experience and the known causes of cervical symptoms – a muscle or ligament injury, a vertebral injury, a neural or cerebral injury and psychological factors. Two questions were added to test specific beliefs – that is, that the cause of the symptoms is ‘whiplash’ and a question regarding the belief that something is irreparably damaged – not specifically related to one of the four dimensions.

The results showed that attributing neck complaints to whiplash has a predictive value over and above the intensity of initial complaints. Therefore, independent of the severity of initial complaints, attributing the perceived complaints to whiplash seems to have a detrimental influence on the prognosis and concurrent disability. This finding not only supports theories regarding the potential influence of culturally embedded causal beliefs, but also has important implications for management and treatment. The present findings suggest that modifying symptom expectations regarding whiplash and altering the causal attribution applied to initial myogenic neck complaints are two possible therapeutic strategies.

The findings are also in line with the ‘nocebo hypothesis’ in which it is proposed that expectations of sickness and the affective state associated with such expectations can cause sickness in the patient.

The present findings also indicate that attributing initial complaints to psychological factors has additional prognostic value regarding the persistence of disability after one year. This finding is consistent with previously presented research, which showed that early anxiety-related distress was related to delayed recovery from post-whiplash syndrome. Cognitive behavioural interventions may also be helpful to reduce the influence of this type of dysfunctional conviction.
Finally, it was found that attributing early complaints to vertebral causes is related to persistent complaints at six months and has borderline significance at twelve-month follow-up. This seems especially important since physiotherapy and/or manual therapies concentrating on alleged vertebral causes are quite common in acute whiplash. In light of the fact that, by definition, no vertebral abnormalities are found in common whiplash, our results suggest that a therapy which implicitly suggests a vertebral cause could have adverse effects by fuelling dysfunctional beliefs.

**Causal beliefs-anxiety model**

The above-mentioned results lead to a new model regarding the development of chronic whiplash complaints. In this ‘causal beliefs-anxiety 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. Increased anxiety levels give rise to increased attention and focus on the perceived symptoms, which are further enhanced by hypervigilance. Increased anxiety levels lead to kinesiophobia and cognitive symptoms due to attention interference, as well as increased muscle tension which leads to increased or continued neck pain. Eventually the process of focusing on perceived pain and anxiety results in central sensitization, in which case nociceptive neurons of pain-modulating systems in the central nervous system are thought to become sensitized. Central sensitization provides a theoretical explanation for unexplained chronic pain.

![Figure 1. causal beliefs-anxiety model](image)
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Methodological discussion

Samples studied
The samples studied consisted of participants who had initiated compensation claim procedures. Since the threshold for starting such procedures is low in the Netherlands, there seems to be no strong reason to suspect that this introduced a bias towards patients whose complaints were more serious.

Firstly, the damage-report forms that are used for claiming car damage, and which are usually completed within a few days of the accident, contain a section for the names of victims and their complaints. We invited all claimants directly on the basis of these forms, including victims who had not visited an emergency room or sought medical help at the time of the accident.

Secondly, although the insurance company and victims can be seen as opposing parties, most personal injury claims in the Netherlands, even large ones that involve serious injuries, are settled out of court. None of the participants was in actual litigation.

Nevertheless, some international studies have found that compensation is a critical factor to consider when studying post-whiplash syndrome. Since no Dutch study regarding the influence of claims of any kind on the course and prognosis of whiplash complaints has been conducted, the influence of this factor in the Dutch context is not clear. However, we feel that at least the personal injury claim context should be taken into account when interpreting or generalizing our findings. Furthermore, since the exact nature and expectations of compensation may vary greatly from country to country, we advise caution when extrapolating results from one population to another.

All the findings based on the Causal Beliefs Questionnaire-Whiplash (CBQ-W) should be interpreted with special care since the connotations regarding whiplash are highly culture-dependent. It could well be that this same questionnaire in a different population, especially with different cultural beliefs regarding neck complaints after motor vehicle accidents, would lead to different results.

Emergency room and hospital visitors vs claimants
Previous research on post-whiplash syndrome has relied predominantly on victims who were recruited from emergency room or hospital visitors, thereby possibly biasing the results towards patients who were more frightened or whose injuries were relatively serious. In the present studies, only a small minority of the car accident victims who were included had actually visited a hospital following the accident. When results show a relationship between the severity of perceived symptoms and the prognosis, as many whiplash-related research does, this recruiting characteristic could be of paramount importance. Furthermore, since the present results reveal that anxiety symptoms are related to the
prognosis, this also shows that recruiting among emergency room visitors could lead to a possible bias. It is feasible that the emergency room visit itself increases the patient's anxiety level, especially when transport by ambulance is involved. It is also possible that the actual emergency room visit is not so much dependent on the professional evaluation of a medical professional but on the level of anxiety of the patient. All in all, it is clear that these assumptions provide ample opportunities for future research, especially since the results could have major consequences for acute trauma support on the accident scene as well as in the emergency room.

**Self-report data**

In the studies presented, patient data was collected using self-report questionnaires. Although this is a widely used and generally accepted form of data collection, some remarks are in order.

It should be acknowledged that any questionnaire-based data holds a risk of self-report bias. While the recruited patients had initiated compensation claim procedures, this gives no reason beforehand to assume that this introduced a bias towards patients whose complaints were more serious. However, although the accompanying letter clearly explained that the research was fully independent from the claim and the results would only be used anonymously and were in no way related to the claim procedure, it cannot be ruled out that this specific context has consequences for the collected data and research results. For instance, it is conceivable that financial arguments gave rise to symptom exaggeration, or a belief that whiplash complaints are more financially beneficial. This cannot be predicted and can only be ruled out by repeating the same research in different populations.

Because the studies presented were limited to self-report data, other research instruments could not be used. Behavioural instruments such as measuring attention bias in cognitive tasks, which would provide further insight into the relationships found and interesting clues for future research, were not feasible in the present context.

**Discussion of results: what can we learn from them?**

The present results regarding work disability and whiplash show that work disability is an important subject when considering the consequences of neck pain after motor vehicle accidents. The results show that concentration complaints are the main symptoms related to the prognosis of work disability. The nature of the work (white or blue-collar) appears to be of minor importance. Therefore, a planned intervention should aim at the cognitive symptoms regardless of the assessed or presumed cognitive load of a certain job. Since neither self-employment nor gender was found to be of relevance, there seems to be no need to incorporate these often-mentioned characteristics into a screening or intervention
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programme. In line with the known research, age was found to be related to the prognosis of work disability. Obviously, age is not a modifiable parameter but should nevertheless be considered when a preventive programme targets high-risk subjects.

The palliative coping style, which was found to be related to the duration of neck pain, includes distractive and avoidant behaviour. It is this avoidant behaviour which provides a link to the fear-avoidance model. Some aspects of this model were investigated. Although kinesiophobia/fear of (re)injury was related to the duration of neck complaints, this relationship diminished when early somatic complaints were considered. From a practical point of view, this symptom-related information is readily available and has been proven to predict the duration of neck complaints over and above kinesiophobia. As a predictive instrument kinesiophobia has no additional value and is therefore not a suitable screening instrument for high-risk patients.

The results show that although kinesiophobia has some interesting relationships (for instance, with neck pain intensity and duration of neck pain when ignoring the intensity of acute somatic complaints) it is not the main variable related to the prognosis. However, the results fuel the idea that anxiety is an important concept in any model describing whiplash.

Post-traumatic stress disorder has been found to be very common after motor vehicle accidents. The present data showed that it is approximately five times more common in patients with neck complaints. Furthermore, the intensity of whiplash-related complaints is associated with concurrent post-traumatic stress disorder symptoms, making it clear that post-traumatic stress disorder is a serious factor which should be considered in all accident victims, but especially in victims exhibiting neck complaints. Inflated physical complaints could give rise to increased catastrophic interpretations and heighten the general anxiety level of an accident victim. The treatment of post-traumatic stress disorder involves examining psychological factors, thereby possibly decreasing somatic attention and hence fixation. Since hyperarousal symptoms, especially, are related to concurrent whiplash complaints as well as to the prognosis of neck complaints, it is clear that characteristic post-traumatic stress disorder symptoms such as avoidance and re-experiencing are of minor importance in whiplash. Because the hyperarousal symptoms closely resemble anxiety-disorder symptoms, this finding seems to indicate that general anxiety symptoms bear an important influence on the perceived severity of whiplash complaints. In line with the results of the research on kinesiophobia, the findings regarding post-traumatic stress disorder symptoms support the view that anxiety can be considered an important factor, although neither of the two anxiety variants can be pointed to as the single responsible factor.

In the fear-avoidance model, threatening illness beliefs and catastrophizing thoughts fuel the dysfunctional process leading to chronic complaints. The present findings
regarding causal attribution suggest that the diagnosis, independent of the severity of symptoms, is related to the prognosis. Recent research has shown that expectations are important in the prognosis of whiplash.\textsuperscript{49} Individuals’ expectations about recovery were found to be important in prognosis, even after controlling for symptom severity. This interesting finding suggests that future interventions should aim to provide more realistic expectations. Another interesting question concerns the origins of these negative and catastrophic expectations. The present results showed that the patients’ early opinion regarding the diagnosis ‘whiplash’ may be of paramount importance here. The results suggest that the term ‘whiplash’ is associated with negative connotations and dysfunctional beliefs regarding the course and prognosis. These dysfunctional beliefs could very well fuel negative thoughts regarding recovery, thereby providing an explanation for the development of negative expectations and providing an even better target for future interventions.

Therefore, the findings suggest modifying symptom expectations regarding whiplash and altering the causal attribution of initial myogenic neck complaints as 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. Although this could lead to a broad and definitive strategy at the population level, it is to be expected that this will be a slow process, taking several years. Altering causal beliefs is an individual process that can be readily employed by developing a cognitive behavioural intervention aimed at modifying these specific causal convictions.

The early opinion or conviction is at least partly formed by physicians and other health workers who make the diagnosis. In light of the fact that the conviction of suffering from ‘whiplash’ is apparently related to a poor prognosis, a simple and easy first step in preventing the development of chronic neck complaints appears to be to no longer use the term ‘whiplash’. ‘Whiplash’ is a strange diagnosis, originally meant to describe a specific movement of the head. It is associated with a large number of atypical symptoms and apparently has a bad name in certain countries, fuelled by catastrophic patient stories and other media attention, which is often commercially driven and aimed more at reaching and entertaining large groups of readers or viewers than providing genuine and correct information.

The next step in early management would be to supply the patient with correct information regarding the complaints and to eliminate catastrophic beliefs regarding the diagnosis, course and prognosis. It is to be expected that at an early stage a limited cognitive intervention could lead to correction of an otherwise catastrophic course.

When complaints persist for a longer period (for example, three months) a structured cognitive behavioural intervention may be employed. Considering the relatively early
stage, it is conceivable that this treatment would be provided by a general practitioner. Increasingly, general practitioners are receiving specialized training in providing cognitive behavioural therapy interventions to deal with unexplained somatic symptoms.\textsuperscript{50}

Patients suffering from persistent symptoms should be referred to specialized centres aimed at treating unexplained somatic complaints.

**Future research and where to go from here**

The present research project showed that work disability is a very relevant factor in the context of neck pain after motor vehicle accidents. The costs of sick leave and disability pensions are higher than the costs of acute medical care, demonstrating that future research should also consider absenteeism from work and work disability, alongside somatic parameters such as complaint severity.

The relevance of coping strategies, the fear-avoidance model, catastrophizing and causal beliefs with regard to work disability, remain unclear but they should all be targets for future research, to gain an insight into the relevance of these factors in relation to work disability.

The important finding - that the prognosis of neck complaints after a motor vehicle accident is related to the early causal belief that the symptoms are the result of whiplash - gives rise to several directions for future research. Since the connotations regarding whiplash are highly culture-dependent, it could well be that the Causal Beliefs Questionnaire-Whiplash (CBQ-W) would lead to different results in a different population, especially when different cultural beliefs regarding neck complaints after motor vehicle accidents exist. Some research in this direction has already been conducted.\textsuperscript{51-53} However, it would be beneficial to investigate expectations and beliefs regarding whiplash in relation to perceived severity, course and prognosis in different populations. It would also be interesting to investigate causal illness beliefs regarding whiplash complaints in emergency room visitors and non-emergency room visitors, to test the assumption that emergency room visitors have stronger somatic beliefs regarding their symptoms, or higher anxiety levels. In addition, it seems worthwhile to investigate whether ambulance transport and an emergency room visit leads to increased anxiety levels. Furthermore, it seems important to learn whether the suggested pathway from dysfunctional causal illness beliefs to negative expectations is indeed correct. This would provide further evidence and steering in the development of future interventions and prevention programmes.

The results of interventions aimed at changing causal beliefs should be investigated. It would be interesting to learn if causal beliefs can be changed, and by what kind of intervention. The effects of interventions aimed at changing causal beliefs should be investigated in terms of the influence on patients’ expectations regarding course and prognosis, as well as on the actual prognosis itself.
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**General conclusions**
The present results clearly show that whiplash complaints should be taken seriously. Not only in terms of delayed recovery but also in terms of work disability. The studies have shown that anxiety and anxiety-related symptoms form an important part of the whiplash complaints presented, although they are not related to recovery. Nevertheless, the results show that post-traumatic stress disorder and pain catastrophizing inflate concurrent whiplash complaints. In addition, post-traumatic stress disorder is five times more prevalent among patients with neck pain, illustrating the importance of considering post-traumatic stress symptoms when evaluating or treating patients with whiplash.

A palliative coping style and hyperarousal symptoms were found to have prognostic value for the persistence of whiplash complaints. In addition, early causal beliefs, including the belief that complaints are caused by ‘whiplash,’ are related to more severe concurrent complaints as well as a poor prognosis for whiplash symptoms. These findings suggest that the early causal beliefs regarding symptoms are of paramount importance, providing a target for future interventions that aim to provide realistic expectations and decrease catastrophic and dysfunctional causal beliefs.

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 revealed regarding the causal role of specific psychological factors in the recovery from whiplash complaints.
References


