Journal of Psychosomatic Research xxx (2013) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Journal of Psychosomatic Research

What characterizes individuals developing chronic whiplash?: The Nord-Trøndelag Health Study (HUNT)

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ARTICLE INFO

Article history:
Received 11 December 2012
Received in revised form 5 February 2013
Accepted 6 February 2013
Available online xxxx

Keywords:
Amplification/attribution
Chronic whiplash
Pre-injury health
Prognostic factors
Risk factors
Self-rated health

ABSTRACT

Objective: Most individuals experiencing whiplash accidents recover rapidly. A considerable proportion, however, develop chronic symptoms. Psychological factors may slow recovery, possibly by increasing the likelihood of other symptoms being misattributed to, and amplified by the whiplash injury. We aimed to investigate how pre-injury mental and somatic symptoms, self-rated health, use of health-services and medications, health-behavior and socio-demographics predict the development of chronic whiplash.
Methods: Data from two waves of a large, population based study (HUNT2 (baseline) and HUNT3) were used. Individuals reporting no whiplash at baseline were identified in HUNT3. Characteristics reported at baseline were compared between those who had developed chronic whiplash in HUNT3 (n = 199) and those who had not (n = 20,600), using Pearson's chi-squared tests, independent sample t-tests and logistic regression analyses.
Results: Individuals developing chronic whiplash reported worse baseline health than those reporting no chronic whiplash. Poor self-rated health was a strong risk factor for subsequent chronic whiplash (OR = 2.26, 95%CI: 1.68–3.04). Musculoskeletal pain also increased the risk (OR = 1.21, 95%CI: 1.15–1.26), as did diffuse somatic symptoms (OR = 2.09, 95%CI: 1.47–2.96), use of different health services (OR = 1.31, 95%CI: 1.19–1.45), high use of medications (OR = 1.28, 95%CI: 1.14–1.43) and symptoms of anxiety (OR = 1.93, 95%CI: 1.39–2.68). Physical activity was protective (OR = 0.67, 95%CI: 0.49–0.91). Most socio-demographic variables were not significantly associated with chronic whiplash.
Conclusion: Poor somatic and mental pre-injury health increased the risk of subsequent chronic whiplash. This suggests that chronic whiplash is not merely an organic disorder, and highlights the importance of individual expectations, symptom reattribution and amplification in development of chronic whiplash.

Introduction

Whiplash is a common term used to describe injuries of the neck usually associated with motor vehicle rear end collisions [1,2]. Whiplash injuries are generally considered uncomplicated soft tissue injuries — fractures and dislocations are excluded [3]. Most patients who experience whiplash injuries recover within a few weeks [1,4,5]. However, a considerable proportion of patients develop chronic whiplash with continued disabling symptoms after six months [1,3,4,6,7].

It has been proposed that psychological factors may slow recovery [8] — possibly by increasing the likelihood of other symptoms being misattributed to the whiplash injury [9]. Patients with chronic whiplash report higher levels of anxiety and depression than the general population [10,11]. They also report more head and neck pain [12–16] and more somatic symptoms from body areas not affected by a neck trauma; like gastrointestinal symptoms, palpitations, shortness of breath and sleep disturbances [12,15,17–20].

An experimental study using placebo rear-end collisions found that 20% of participants reported a whiplash injury 1–3 days after the "accident" [21]. Further, symptom reporting was more common among participants with greater levels of self-reported emotional distress and health concerns before the "accident" [21]. Reviews of psychological risk factors in back and neck pain have also confirmed the

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http://dx.doi.org/10.1016/j.jpsychores.2013.02.004

association between psychological distress, anxiety and depression and the chronicity of neck and back injuries [22,23].

The fact that recovery from whiplash and prognosis seems to vary strongly by country also highlights the role of psychological expectations in recovery. Low rates of continuing disability following whiplash injury have been found in Greece, Germany and Lithuania. In Norway and North America where, it has been argued, the populations are more aware of whiplash following car accidents and have expectations of continuing symptoms following the injury, high rates have been found [24]. A recent Swedish study found a strong relationship between expectations of recovery measured soon after the whiplash injury and disability at six months [25]. Individuals who did not expect to fully recover were more likely to be disabled at follow-up.

The disentangling of the role of psychological factors in whiplash injury disability is difficult in cross-sectional research and even in longitudinal studies where data is not collected prior to the accident. Recently, work using large epidemiological datasets has allowed the examination of how prognostic variables collected before the whiplash injury influence recovery trajectories.

In this study, we used data from two waves of a large, population based Norwegian study (HUNT2 and HUNT3) to investigate how prior perceived health, use of health-services, health behavior, musculoskeletal complaints, diffuse somatic symptoms, previous medical diagnoses as well as depression and anxiety predicted development of chronic whiplash. Based on previous cross-sectional studies we hypothesized that previous symptom complaints and anxiety and depression in particular would be associated with the development of a chronic whiplash condition.

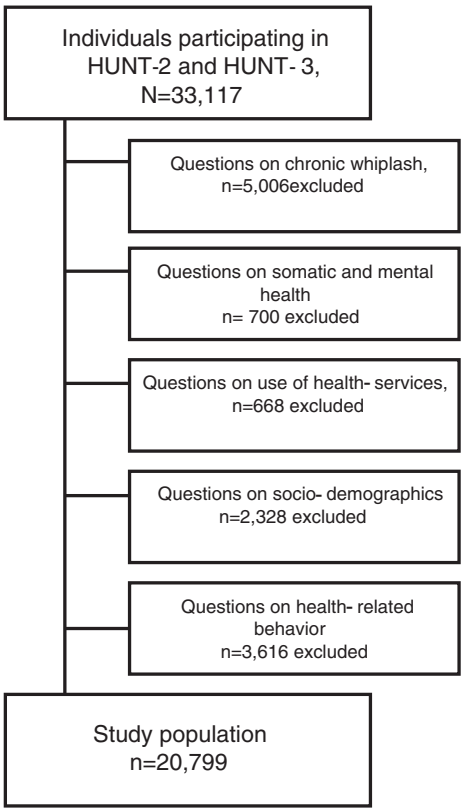

Fig. 1. Participants excluded, study population, the HUNT-study.

Method

Study design and population

Data from the second and third wave of the "Nord-Trøndelag Health Study" (HUNT2 and HUNT3) were employed in this prospective cohort study. Nord-Trøndelag is one of 19 counties in Norway, and largely characteristic of the national population, though slightly less urban and with lower educational attainment [26]. The HUNT2 study was conducted from 1995 to 1997, HUNT3 from 2006 to 2008.

All inhabitants in Nord-Trøndelag County aged >19 (n = 93,574 for HUNT2 and n = 93,860 for HUNT3) years received mailed questionnaires and an invitation to a clinical examination including measurement of height and weight, waist circumference, blood pressure, lung function and blood samples. Out of these individuals, n = 33,117 participated in both HUNT2 and HUNT3 and were eligible for our analysis.

Variables included

Chronic whiplash

Chronic whiplash constituted our grouping variable. In both HUNT2 and HUNT3 participants were asked "Have you ever experienced a whiplash injury" and age at time of the injury. Participants reporting whiplash at baseline (HUNT2) (n = 899) were excluded.

In HUNT3, the n = 30,008 reporting no whiplash in HUNT2 were identified and classified into those having developed chronic whiplash and those who had not. Chronic whiplash was defined as having experienced a whiplash injury more than 1 year ago (excluding n = 31 individuals possibly still in the acute phase of injury) and reporting neck-pain. Those reporting a whiplash-injury and no neck-pain were classified as non-sufferers. A total of n = 5006 individuals were excluded in relation to questions on chronic whiplash (participants reporting whiplash in HUNT2, participants reporting a too recent whiplash injury in HUNT3 and participants not responding to items on whiplash in HUNT2 and HUNT3) (see Fig. 1).

Self-rated health

Self-rated health was evaluated by the question "How would you describe you present health?" with four possible responses "very good", "good", "not all good" and "bad". These were dichotomized into good (very good, good) and bad (not all good, bad). The n = 190 participants not responding to this item were excluded. Self-rated health has been found to be a valid health measure appropriate for use in general health surveys [27].

Somatic health

As in previous research [18,28,29], musculoskeletal complaints were measured using an instrument adopted from the Standardized Nordic Questionnaire [30] which has been found to yield reliable estimates for upper limb and neck discomfort [30–32]. Participants were asked if they during the last year had experienced musculoskeletal pain/stiffness in specific body parts for a minimum of 3 consecutive months, with response options "neck", "shoulders", "elbows", "wrists, hands", "chest, abdomen", "upper back", "lower back", "hips", "knees" and/or "ankles/feet". A new variable describing musculoskeletal complaints, ranging from 0 to 10, was computed by counting the total number of sites endorsed by each individual. Participants not endorsing any painful area (n = 15,263) were classified as having no pain.

Participants were also asked if pain had kept them from doing daily activities at work the last month. The n = 9562 individuals not responding to this item were set as not being kept from working due to pain — as 78.1% of them in the previous item reported no musculoskeletal pain.

Diffuse somatic symptoms were evaluated by asking to what degree participants had been bothered by "nausea", "heartburn", "diarrhea", "constipation", "palpitations" and "breathlessness" during the last year. Response options were "not bothered", "bothered some" or "bothered a lot". The last two categories were grouped together. A dichotomous variable was created, grouping individuals with a

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cutoff of two diffuse complaints. Individuals not answering the question (n = 283) were excluded.

Participants also indicated whether they had the following past or present somatic diagnoses: cardiac infarction, angina pectoris, stroke, asthma, diabetes, osteoporosis, fibromyalgia, arthrosis, spondylarthritis, other musculoskeletal disorder or epilepsy. All participants answered these questions, and positive responses were counted for each participant.

Mental health

Mental health was measured using the "Hospital Anxiety and Depression Scale" (HADS) [33]. HADS is a widely used self-report questionnaire considered valid and reliable for patients in psychiatric and non-psychiatric clinical settings, and for the general population [34–36]. For the analysis, a dichotomous variable using the recommended cut-off of 8 was used [34]. Participants reporting anxiety but not answering for depression (n = 26) were classified as having anxiety but not depression, the ones reporting depression but not answering for anxiety (n = 129) were classified as having depression but not anxiety. The n = 227 participants answering neither items for depression, nor for anxiety were excluded.

Further, comorbid anxiety and depression was investigated. A new variable was constructed and individuals reporting a HADS-score over 8 on both depression and anxiety in HUNT2 were classified as having comorbid anxiety and depression.

Use of health-services and medications

Participants were asked if during the last year they had visited a "general practitioner (GP)", "company doctor", "doctor at hospital", "other doctor", "physiotherapist", "chiropractor", "homeopath" or a "different healer/doctor of natural medicine". Participants were also asked if they had been admitted to the hospital during the last five years. For each individual, the total number of different health-services used was counted and the n = 668 not answering the question were excluded.

Participants were asked how many months during the last year they had used different medications. The medications investigated were cod-liver, medications for allergy, pain-killers, asthma medication, heart medication, anti-depressants, iron-supplements, sedatives, sleeping-pills, vitamin-D and "others". A variable was constructed, representing the total number of medications that had been used for at least one month for each individual. Individuals not answering were classified as not using medications.

Socio-demographics

Gender and age at participation were collected for each participant. Marital status was evaluated by asking if participants were "married", "not married", "separated/divorced" or "widow/widower".

Participants were asked if they currently received "sick pay", "rehabilitation benefits", "disability pension" or "unemployment benefits". The validity of self-reported rehabilitation benefits [37] and disability pension [37,38] has been found to be good, the validity of self-reported sick leave, somewhat lower [38–40]. For our analyses, "sick pay" and "rehabilitation benefits" were grouped together and labeled "Short term health related benefits". Disability pension was labeled "Long term health related benefits". Participants not answering questions on marital status or benefits (n = 2328) were excluded.

Health-related behavior

Participants were grouped as smokers and non-smokers based on the question "Do you smoke cigarettes/cigars/pipe daily?"

Amount of alcohol consumption was assessed using two questions: "Do you abstain from alcohol?" and "What is your normal consumption of alcoholic beverages over a two week period?" As in previous studies, a cut-off value of 15 units was used [41], and participants

Table 1
Comparing variables at base line, the HUNT-study, N = 20,799

	Chronic whiplash N = 199	No chronic whiplash N = 20,600	p-Values	OR (95% CI)
Socio-demographics				
Female	58.3%	54.5%	0.278	1.17 (0.88–1.55)
Age at participation	42.43 (10.64)	44.39 (11.94)	**0.021**	0.99 (0.97–1.00)
Marital status			0.322	
Married	67.8%	68.1%		Ref.
Not married	18.1%	22.6%		0.80 (0.55–1.16)
Separated/divorced	11.6%	6.7%		1.72 (1.10–2.69)
Widow/widower	2.5%	2.5%		1.01 (0.41–2.48)
Receipt of benefits				
Short term health related benefits	8.0%	4.4%	**0.012**	1.92 (1.15–3.22)
Long term health related benefits	7.0%	6.3%	0.669	1.13 (0.65–1.94)
Unemployment benefits	7.5%	5.8%	0.290	1.33 (0.78–2.26)
Health-related behavior				
Smoking	26.6%	26.5%	0.960	1.01 (0.74–1.38)
Alcohol consumption			0.530	
No consumption	30.7%	28.8%		Ref.
Normal consumption	67.3%	68.9%		0.92 (0.68–1.24)
Heavy consumption	2.0%	2.3%		0.81 (0.29–2.23)
Physical activity	70.9%	78.5%	**0.009**	0.67 (0.49–0.91)
Use of health-services/medications				
Use of health-services	2.21 (1.34)	1.74 (1.25)	<**0.001**	1.31 (1.19–1.45)
Use of medications	1.02 (1.22)	0.71 (1.01)	<**0.001**	1.28 (1.14–1.43)
Self-rated health (bad)	33.2%	18.0%	<**0.001**	2.26 (1.68–3.04)
Somatic health				
Musculoskeletal symptoms	2.86 (2.76)	1.50 (2.26)	<**0.001**	1.21 (1.15–1.26)
More than two diffuse complaints	20.1%	10.8%	<**0.001**	2.09 (1.47–2.96)
Kept from working due to pain	26.1%	13.3%	<**0.001**	2.31 (1.68–3.18)
Comorbid somatic diagnoses	0.43 (0.79)	0.29 (0.60)	**0.002**	1.34 (1.11–1.60)
Mental health				
Anxiety, HADS	23.6%	13.8%	<**0.001**	1.93 (1.39–2.68)
Depression, HADS	12.1%	8.2%	0.050	1.53 (1.00–2.35)
Comorbid anxiety and depression	9.1%	4.6%	0.003	2.06 (1.26–3.36)

Percentages or mean (SD). Statistically significant p-values in bold.

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were grouped to have "no consumption", "moderate consumption", or "high consumption".

Participants were asked how often, and for how long, they engaged in both light and intense leisure-time physical activity. Individuals were then grouped as those performing physical activity and those not performing physical activity. Participants not answering items on smoking, alcohol consumption or physical activity (n = 3616) were excluded.

Statistical procedure

Characteristics reported at baseline (HUNT2) were compared between individuals reporting chronic whiplash in HUNT3 and those not. Pearson's chi-squared test and independent sample t-tests were employed. Logistic regression analyses were used to examine the relationship between baseline variables and subsequent chronic whiplash. Precision of the estimated association were assessed by a 95% confidence interval (CI). As most background variables did not differ between the two groups, only results from crude analysis are presented.

As described above, list-wise deletion was used to handle missing information. Also, using multiple missing imputation, 5 new datasets were created. Each of the imputed datasets was analyzed and the results were combined to produce estimates and confidence intervals. As most findings did not differ between the original and the imputed datasets, results from the original data are presented.

STATA/IC 11.0 [42] for Windows 7, PC, was used for all analyses.

Ethics

The HUNT2 and HUNT3 surveys were approved by the Regional Committee for Ethics in Medical Research and the Norwegian Data Inspectorate. Written informed consent was obtained from all subjects. The present study was approved by the Regional Committee for Ethics in Medical Research.

Results

Our study population consisted of n = 20,799 individuals. The mean age at HUNT2 participation was 44.4 years (SD = 11.9, range 19–78). Of the participants, 54.5% were female, 68.1% were married and 15.9% were receiving benefits.

As detailed in Table 1, neither age, gender, alcohol consumption nor smoking increased the risk of subsequent chronic whiplash. However, we found that physical activity significantly reduced the risk of chronic whiplash by app. 40%. Receiving short term health-related benefits increased the risk by app. 65%, whereas long term health related benefits and unemployment benefits did not increase the risk. Compared with being married, being separated or divorced increased the risk of subsequent chronic whiplash by app. 54%.

Individuals reporting chronic whiplash in HUNT3 reported worse general health at baseline (HUNT2) than those reporting no chronic whiplash. Poor self-rated health at baseline was found to be a strong risk factor for subsequent chronic whiplash, with odds of 2.26, and also musculoskeletal pain and diffuse somatic symptoms at baseline increased the risk of subsequent chronic whiplash (see Table 1 for details).

Both use of medications and health-care services significantly increased the risk of subsequent chronic whiplash. As detailed in Fig. 2, individuals who later developed chronic whiplash reported more visits to their GP, hospital doctors, physiotherapists, alternative therapists and more hospital admissions. This group also used significantly more analgesics and sedatives and more medications for allergies and asthma (Fig. 3). As the number of different health-services visited and the number of medications used increased, so did the odds of subsequent chronic whiplash (Fig. 4).

Anxiety at baseline was significantly associated with subsequent chronic whiplash, (OR = 1.93). The risk was even higher for comorbid anxiety and depression (OR = 2.06).

Discussion

Summary of results

The aim of this study was to investigate the prognostic importance of pre-injury health, self-rated health, use of health-services and medications, socioeconomic status and health-related behavior on the development of chronic whiplash. In short, we found that individuals who later developed chronic whiplash reported worse pre-injury somatic and mental health. One of the strongest risk factors for developing chronic whiplash was poor self-rated health at baseline. Use of different health-services and elevated use of medications also predicted chronic whiplash. Physical activity reduced the likelihood of developing chronic whiplash.

Interpretation of findings

In line with previous studies pre-injury somatic and mental health were found to strongly predict subsequent chronic whiplash [29,43,44]. One explanation of this finding would be that individuals

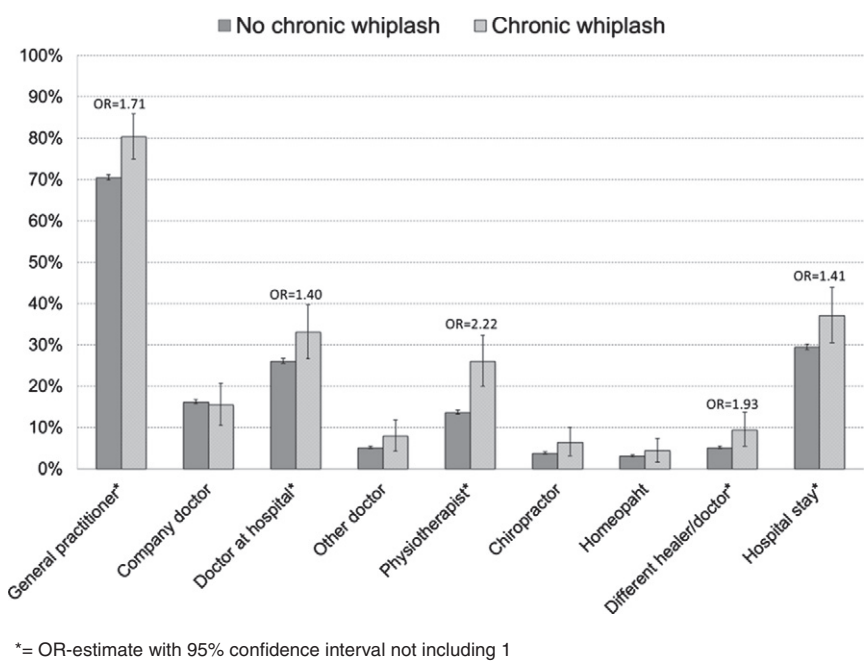

Fig. 2. Use of health-services at baseline. Comparison between individuals later developing chronic whiplash (n = 199) and individuals not developing chronic whiplash (n = 20,600), the HUNT-study.

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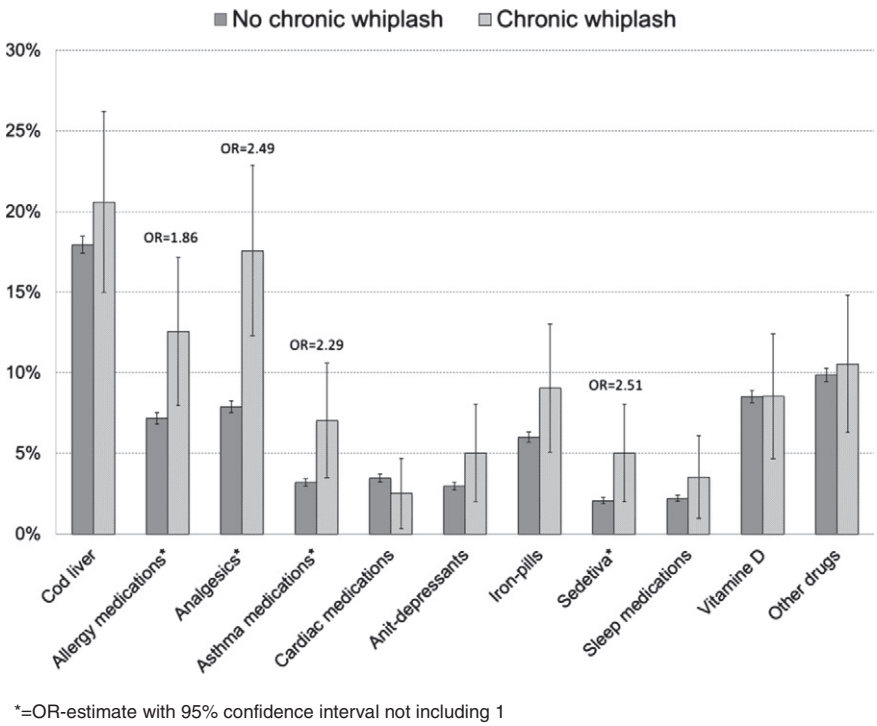

Fig. 3. Use of medications at baseline. Comparison between individuals later developing chronic whiplash (n = 199) and individuals not developing chronic whiplash (n = 20,600), the HUNT-study.

with worse health are more likely to be victims of traffic accidents. If these individuals experience concentration problems and are less watchful or vigilant in traffic, some of this increased risk may be expected. Individuals with worse health might also use more sedatives, antidepressants or sleeping medications which may affect their driving ability. In the current study, participants developing chronic whiplash did report a significantly higher use of medications at baseline, and the use of sedatives increased the risk of subsequent chronic whiplash. Thus, use of medications could explain some of the increased risk of developing chronic whiplash. Whiplash traumas are, however, usually the result of rear-end collisions, where the concentration and attention of the victim are likely to be of minor importance. A more plausible explanation for the association between medications and chronic whiplash could be that increased use of medications like analgesics and sedatives expresses increased bodily awareness. As discussed below, this might increase the risk of developing chronic symptoms if exposed to a whiplash accident.

Use of different health-services also increased the odds of subsequent chronic whiplash. As demonstrated in several medically unexplained conditions, taking on a role as patient may amplify symptoms and make recovery more difficult [9,45]. Frequent testing and visits to doctors have provided little reassurance to these patients and can result in increased level of worry and anxiety [9]. Consistent with this finding, abundant health care at an early stage following whiplash injuries has been linked to delayed recovery [46].

GPs have traditionally given victims of whiplash accidents recommendations to rest the neck and supplied information on the comfort and support provided by soft collars [47]. As our data were gathered from 1995 to 1997 (baseline, HUNT2), the individuals studied were most likely given such information. However, fear of movement is important in development of chronic problems after whiplash accidents [48] and in other chronic pain conditions [49].

We found that physical activity significantly reduced the odds of subsequent chronic whiplash, which corresponds well with previous studies suggesting that active treatments are more effective [4,46,47,50,51].

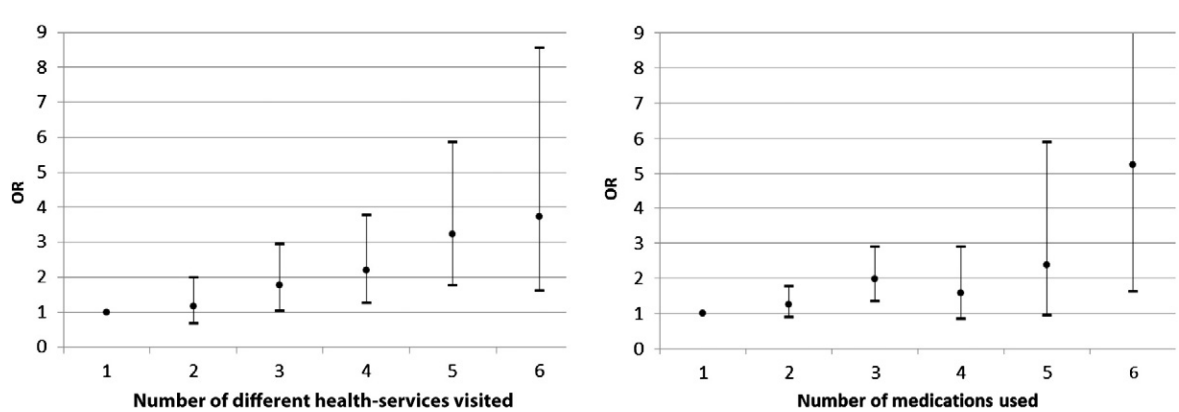

Fig. 4. Association between subsequent chronic whiplash, and use of health services and use of medications at baseline (odds ratio (point estimate and 95%CI)), the HUNT-study.

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Patients should be encouraged to do neck exercises [47] and remain physically active [45,52]. To the best of our knowledge, no other studies have investigated the prognostic importance of pre-injury physical activity on chronic whiplash, and a review from 2008 highlighted the lack of such information [53]. How physical activity reduces the risk of chronic whiplash is not possible to investigate in this study, although it seems plausible that physically active individuals are more likely to remain active and not adapt a passive coping strategy or fear avoidance after whiplash accidents. Further, physical activity reduces the risk of experiencing depressive symptoms [54–56] — and mental health problems have been found to be strong risk factors for the development of chronic whiplash [29,57].

Rather than increasing the risk of being exposed to a whiplash accident, it might seem that, if exposed, poor pre-injury health increases the probability of developing chronic problems following the accident. Previous studies have found prior pain to predict pain-conditions after acute pain [43,44]. The process of sensitization [58] might explain this, and indeed sensitization has been reported in whiplash patients [59,60].

There are, however, also alternative hypotheses. Poor self-rated health was found more important for the risk of subsequent chronic whiplash than somatic or mental health complaints. This might indicate that certain individuals are more "somatically aware" than others. Barsky suggests that the more convinced patients are that their symptoms are serious and pathogenic, the more intense, prolonged and disabling the symptoms become [9]. Individuals with negative health views might be more likely to consider whiplash injury a bad and disabling experience. This can increase the risk of reattribution of pre-existing symptoms to the injury, and further amplification of these. The importance of reattribution and amplification in chronic whiplash has been emphasized in previous studies [9,24,57,61].

The current study also found that anxiety increased the risk of subsequent chronic whiplash. Some researchers consider anxiety and depression as the result of chronic pain following a whiplash injury [62]. Anxiety and depression can also function as mediators [63], leading to increasing load of somatic symptoms, reduced quality of life and reduced ability to work [64,65]. In our study, however, symptoms of anxiety were present before the injury and must be explained differently. Individuals with no anxiety exposed to a whiplash accident might be among the individuals quickly recovering and forgetting the incident. Individuals with anxiety are more likely to experience prolonged suffering: reattribution and amplification of symptoms are believed to be stronger in individuals suffering from mental health problems [9].

Previous studies support the importance of anxiety and self-rated health on prolonged suffering from chronic whiplash. Psychological factors in relation to the accident have been found to be of prognostic importance [66,67]. For instance, the feeling of being innocent in relation to the accident, and being angry or worried, predict a worse outcome [68,69]. Pain-related fear and avoidance appear to be essential in developing chronic problems [48,49], and worrying and poor expectations for recovery predict prolonged suffering [25,70]. Further, placebo rear-end collisions without biomechanical potential for injury might give rise to head and neck pain [21], while individuals experiencing whiplash in relation to sports stand out from other whiplash victims with their absence of chronic symptoms and disability [45]. Such findings indicate that contextual and psychological factors are important in the development of chronic whiplash.

Age and gender have in previous research been found associated with adverse prognosis after whiplash [71,72]. However, one systematic review found conflicting results regarding the prognostic value of age and gender [53], while another systematic review stated that there is strong evidence for older age and female gender *not* being associated with an adverse prognosis [73]. We found gender to be unrelated to outcome and older age to be slightly protective. Based on our findings, we have no reason to claim that age and gender are of great prognostic importance in chronic whiplash.

Strengths and limitations

A major advantage of this study is the prospective cohort design, avoiding problems related to recall-bias and attribution. This is important given that a tendency to underestimate pre-injury symptoms [74] is commonly found. Also, neither participants nor administrators were aware of any specific hypothesis or focus.

Further, the response rate of the HUNT-study was relatively high and the sample population size was very large. The population-based information also enables us to study all participants self-reporting chronic whiplash. If patients were found at clinics, this could have led to selection bias where only the most severely ill patients were studied.

This study is based on self-reported information with no medical or register confirmation. Some of the measures used have been validated, others have not. Though most measures have been used in previous publications, the lack of information on validity is a limitation to the study.

The main variable investigated, chronic whiplash, has some limitations. Individuals self-report having experienced a whiplash accident — not that they presently suffer from chronic whiplash. To more closely define our group as actual sufferers of chronic whiplash, we included only individuals reporting neck pain, and excluded individuals possibly still in the acute phase of the disorder. Individuals reporting having experienced a whiplash injury and neck pain – even if the pain is due to something else – were included in our chronic whiplash group. Previous studies have used self-reported data and similar methods of classification when investigating chronic whiplash [10,18], but the lack of a medical confirmation is a limitation to this study.

Self-report potentially leads to the problem of missing information. As described above, this was handled using list-wise deletion and missing imputation. Most findings did not differ between original and computed datasets. For depression and long term sickness benefits, however, odds for subsequent chronic whiplash were similar but went from non-significant when using list-wise deletion to significant when imputing. This could be due to the increase in power, when going from 199 individuals reporting chronic whiplash when using list wise deletion to 378 when using multiple imputation.

As participants in HUNT2 and 3 were not asked about physical factors like direction, speed or velocity in relation to the accident, we were unable to investigate the prognostic importance of such physical factors. Previous research has, however, investigated collision-related factors, and concluded that most of them seem unrelated to the outcome [3,43,53].

Conclusion

Poor somatic and mental pre-injury health increased the risk of subsequent chronic whiplash. This supports the growing body of evidence claiming that chronic whiplash is not merely an organic disorder, and highlights the importance of individual expectations, and symptom reattribution and amplification on the development and maintenance of chronic whiplash. Physicians should encourage the patient to resume normal activity, remain at work and be physically active. Negative expectations about the clinical course and prognosis should be minimized and the patient should be discouraged from assuming a sick-role.

Abbreviations

CI	Confidence interval
GP	General practitioner

Conflict of interest

The authors have no competing interests to report.

Acknowledgments

Funding for purchase of rights to analyze data was obtained from the Norwegian Institute of Public Health and the Western Norway Regional Health Authority. The sponsors had no role in creating study design, in the collection, analysis and interpretation of data, in the writing of the report or in the decision to submit the article for publication.

Data were obtained from the Norwegian Office for Social Insurance and The Nord-Trøndelag Health Study (The HUNT Study, a collaboration between the HUNT Research Centre, Faculty of Medicine, Norwegian University of Science and Technology (NTNU, Verdal), Norwegian Institute of Public Health, and Nord-Trøndelag County Council).

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Please cite this article as: Myrtveit SM, et al, What characterizes individuals developing chronic whiplash?: The Nord-Trøndelag Health Study (HUNT), J Psychosom Res (2013), http://dx.doi.org/10.1016/j.jpsychores.2013.02.004