

Relationship Between Psychosocial Factors and Pain in the Jaw and Neck Regions Shortly After Whiplash Trauma

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Aims: To assess jaw pain shortly after whiplash trauma in relation to neck pain, physical symptoms, depression, and jaw pain-related disability. **Methods:** A total of 181 cases (106 women and 75 men, mean ages 33.7 and 36.8 years, respectively) were examined within 1 month after a whiplash trauma and compared to 117 controls (68 women and 49 men, 34.2 and 30.9 years, respectively). Participants rated current jaw and neck pain intensity on a numeric rating scale and rated nonspecific physical symptoms and depression symptoms on subscales of the Symptom Checklist-90-Revised. The nonspecific physical symptoms were further analyzed with and without pain items. Disability related to jaw pain and neck pain was also assessed. Differences between groups were calculated using Mann-Whitney *U* test, and correlations were measured using Spearman correlation. **Results:** Compared to controls, cases reported higher current jaw and neck pain intensity ($P < .0001$), together with higher scores for physical nonpain and pain symptoms, depression, and jaw pain-related disability ($P < .0001$ for all). For cases, there were moderate correlations between nonspecific physical symptoms and jaw pain and neck pain, as well as between jaw pain-related disability and jaw pain and neck pain ($r = 0.43$ to 0.77 , $P < .0001$ for all). Low correlations were observed between depression and jaw pain and neck pain ($r = 0.34$ to 0.39 , both $P < .0001$). **Conclusion:** Shortly after a whiplash trauma, pain in the jaw and neck regions is associated with the severity of psychosocial factors. Thus, psychosocial factors may play a role in the development of pain in the jaw region after whiplash trauma. *J Oral Facial Pain Headache* 2019;33:213–219. doi: 10.11607/ofph.2226

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Jaw pain and dysfunction, also termed as temporomandibular disorders (TMD), are the most common cause for chronic pain in the orofacial region. This musculoskeletal disorder is characterized by pain and impaired function involving the jaw muscles, the temporomandibular joint (TMJ), and associated structures.¹ Pain is multidimensional and complex, sculpted by different external and internal factors to form the individual experience of pain.² The biopsychosocial model was introduced to take into account the interaction between the different biologic, psychological, and social factors and their relation to the health of the individual.³ Psychosocial factors incorporate the individual's psychological attributes, such as anxiety and depression, and social attributes, such as the environment at home and at work. The importance of such psychosocial factors, especially in chronic pain conditions, has been firmly demonstrated.⁴

In line with the above, psychosocial factors were included in the diagnostic system the Research Diagnostic Criteria for TMD (RDC/TMD), which was introduced in 1992.¹ The RDC/TMD is a dual-axis system that includes diagnosis of physical symptoms (Axis I) together with assessment of psychosocial factors (Axis II) to classify the global severity and impact of pain.¹ This dual-axis system was retained in the updated Diagnostic Criteria for TMD (DC/TMD), which was published in 2014.⁵ A range of studies have supported the importance of including psychosocial factors such as anxiety, depression, and catastrophizing in the assessment of patients with TMD. It was demonstrated that

psychosocial factors are associated with and influence the incidence of TMD,⁶ with frequency of somatic symptoms being the strongest predictor.⁷ In chronic TMD, there is support for an association between pain and psychosocial factors (for example, somatic symptoms and depression).^{8,9}

TMD has a multifactorial etiology. One factor that can putatively contribute to its development is whiplash trauma.¹⁰ A whiplash trauma is defined as an extension-flexion trauma to the neck, most often from a rear-end car accident, and has an incidence in the general population of about 2 per 1,000.¹¹ Most individuals are assumed to recover, but about one in three will develop chronic neck pain and disability along with other symptoms such as headache, dizziness, and pain in other body regions. These symptoms are embraced as whiplash-associated disorders (WAD).¹² For individuals with acute whiplash trauma, high initial neck pain and neck disability are the strongest prognostic factors for poor outcome. Many studies on TMD following a whiplash trauma report that jaw pain develops over time and not in the acute phase after neck trauma.¹³ However, in a recent study, jaw pain was reported within 1 month after the trauma, indicating that jaw pain may also be part of the acute stage after a neck trauma.¹⁴ Furthermore, it was suggested that intensity of neck pain was also a possible risk factor for the development of orofacial pain. However, the pathophysiologic mechanisms and the possible role of psychosocial factors underlying the development of jaw pain following whiplash trauma remain unclear. To address this gap in knowledge, there is a need to assess psychosocial factors in relation to jaw pain in close proximity to neck trauma.

The aim of the present study was to analyze somatic symptoms, depression, and pain-related disability in relation to jaw pain and neck pain shortly after a whiplash trauma. The null hypothesis was that there would be no differences between cases with a recent whiplash trauma and controls without a history of neck trauma with regard to severity of nonspecific physical symptoms, depression, and pain-related disability.

Materials and Methods

Study Population

Between November 2010 and January 2016, a total of 386 eligible individuals visited the Emergency Department at Umeå University Hospital, Sweden following a whiplash trauma in a car accident. These individuals were consecutively invited to participate in this cross-sectional case-control study via the hospital's injury database. A total of 181 cases (47%) participated.

Participants were included if they had visited the Emergency Department with neck pain within 72 hours after a car accident and had been diagnosed with neck distortion (ICD-10-S13.4) by a physician. The cases were examined within 1 month after the whiplash trauma. Cases with WAD grade IV (fracture)¹⁵ were excluded. The 117 age- and gender-matched controls were consecutively invited by advertisement, and previous neck trauma was the only exclusion criterion. Inclusion criteria for both groups were residency in Umeå municipality and aged 18 to 70 years. All participants completed established questionnaires with good validity and reliability for jaw and neck pain, neck disability, psychosocial symptoms, and pain-related disability.

This study was approved by the Regional Ethical Review Board in Umeå, Sweden and was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies. All participants signed written informed consent prior to enrollment and were free to omit any item in the questionnaires or withdraw from the study at any time without providing an explanation.

Questionnaires

The Neck Disability Index (NDI) assesses the impact of neck pain on daily activities such as personal care, lifting, reading, concentration, working, and sleeping, as well as headache and neck pain intensity. The 10 items are individually rated on a 6-point Likert scale from 0 (no disability) to 5 (complete disability). The sum score of 0 to 50 is transformed to a 0% to 100% scale by multiplying the total score by 2. The NDI scores are categorized as: 0% ≤ 8% = no disability; > 8% ≤ 28% = mild; > 28% ≤ 48% = moderate; > 48% ≤ 68% = severe; and > 68% ≤ 100% = complete disability.¹⁶

Current pain intensity in the neck region (denoted neck pain) and in the face/mouth region (denoted jaw pain) were rated on numeric rating scales (NRS)¹⁷ graded from 0 (no pain) to 10 (worst pain).

Psychologic status and disability related to jaw pain were assessed according to Axis II of the RDC/TMD. The Axis II questionnaire includes assessment of jaw pain intensity, jaw pain-related disability, nonspecific physical symptoms, and depression. Assessment of nonspecific physical symptoms level is based on the somatization scale and depression levels on the depression scale,¹ both instruments adapted from the Symptom Checklist-90-Revised (SCL-90-R).¹⁸ The nonspecific physical symptoms scale is comprised of 12 items, including both pain and nonpain-related items. The scale can be further divided into a subscale for nonpain physical symptoms (seven items) by excluding the pain-related

Table 1 Demographic and Descriptive Data for Cases with a Whiplash Trauma (n = 181) and Controls (n = 117)

	Cases			Controls		
	Total	Women	Men	Total	Women	Men
Total, n (%)	181 (100)	106 (58.6)	75 (41.4)	117 (100)	68 (58.1)	49 (41.9)
Age (y), mean (SD)	35.0 (14.4)	33.7 (14.4)	36.8 (14.3)	32.8 (12.7)	34.2 (13.1)	30.9 (11.9)
NDI, median (IQR)	12 (4–25)	15 (4–30)	10 (4–20)	2 (0–4)	2 (2–6)	2 (0–4)
Jaw pain ≥ 4 on NRS, n (%)	19 (10.5)	15 (14.2)	4 (5.3)	0 (100)	0 (100)	0 (100)

SD = standard deviation; NDI = Neck Disability Index (0–100); IQR = interquartile range; NRS = numeric rating scale (0–10).

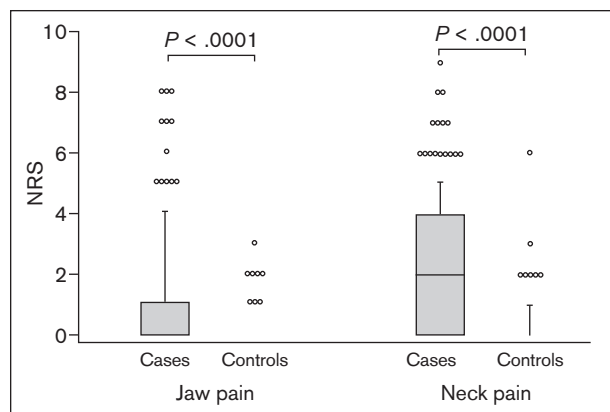


Fig 1 Jaw and neck pain for cases (n = 181) and controls (n = 117) rated on a 0–10 numeric rating scale (NRS).

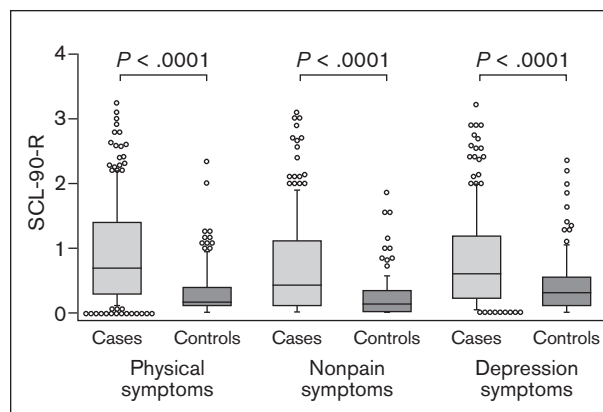


Fig 2 Physical, nonpain physical, and depression scores for cases (n = 181) and controls (n = 117) rated on the SCL-90-R scale (0–4).

items. The depression scale (containing vegetative symptoms) includes 20 items. The severity of each item is rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (very much). The mean of the item ratings provides the sum score for nonspecific physical symptoms and depression. The severity for each individual subscale and subgroup is classified as normal, moderate, or severe in accordance with normative values.¹

Disability score (DS) related to jaw pain was the mean value of three questions on how jaw pain affects the ability to carry out daily, social, and work activities, scored 0 to 100.

Statistical Analyses

Descriptive statistics are presented as mean (age) and median (other variables). Gender differences between the case and control groups and differences in pain-related disability score were analyzed with Fisher exact test. Differences between cases and controls for age, NRS, NDI, and nonspecific physical symptoms and depression were analyzed with Mann-Whitney *U* test. Correlations between jaw and neck pain intensity and pain-related disability, nonspecific physical symptoms, and depression were evaluated with Spearman correlation. A *P* value < .05 was regarded as statistically significant.

Results

Demographic characteristics and descriptive data for cases and controls are presented in Table 1. There were no significant differences between the case and control groups with regard to age (*P* = .468) or gender (*P* > .999). Jaw pain intensity ≥ 4 on the NRS was not reported by any of the controls, but was reported by 10.5% of the individuals in the case group (Table 1). Compared to the control group, cases reported a significantly higher neck disability score (*P* < .0001) (Table 1) and higher pain intensity in both the jaw and neck regions (Fig 1).

Cases reported higher median scores than controls for all nonspecific physical symptoms, both with pain items included (0.700 vs 0.167, respectively) and excluded (0.429 vs 0.143, respectively). Cases also reported a higher median degree of depression (0.60) compared to controls (0.30) (Fig 2). For pain-related disability, 22% of cases had a disability score ≥ 1 , compared to 9% of the controls (*P* = .002). When compared to normative values,¹ more than half of the cases had moderate or severe scores for all psychosocial variables, whereas the majority of individuals in the control group were classified within the normal score classification (Table 2).

Table 2 Neck Disability Index (NDI) and Psychosocial Variables for Cases (n = 181) and Controls (n = 117) Distributed According to Normative Values

Variables		Cases, n (%)	Controls, n (%)
NDI			
No disability	0 ≤ 8	76 (42.0)	102 (87.2)
Mild disability	> 8 ≤ 28	70 (38.7)	11 (9.4)
Moderate disability	> 28 ≤ 48	25 (13.8)	1 (0.8)
Severe disability	> 48 ≤ 68	9 (5.0)	0 (0)
Complete disability	> 68 ≤ 100	1 (0.5)	0 (0)
Physical symptoms (SCL-90-R) ²			
Normal	(< 0.500)	59 (32.6)	90 (76.9)
Moderate	(0.500 to < 1.000)	52 (28.7)	16 (13.7)
Severe	(≥ 1.000)	70 (38.7)	11 (9.4)
Nonpain physical symptoms (SCL-90-R)			
Normal	(< 0.428)	87 (48.1)	88 (75.2)
Moderate	(0.428 to < 0.857)	35 (19.3)	21 (17.9)
Severe	(≥ 0.857)	59 (32.6)	8 (6.8)
Depression			
Normal	(< 0.535)	86 (47.5)	84 (71.8)
Moderate	(0.535 to < 1.105)	45 (24.9)	24 (20.5)
Severe	(≥ 1.105)	50 (27.6)	9 (7.7)

SCL-90-R = Symptom Checklist-90-Revised.

For cases, nonspecific physical symptoms showed a moderate correlation with jaw pain and with neck pain (Fig 3a). These correlations were also moderate for nonpain physical symptoms (Fig 3b). The correlations between depression and both jaw pain and neck pain were low (Fig 3c). There were also moderate positive correlations between the disability score related to jaw pain and both jaw and neck pain (Fig 4). For the control group, there were no correlations between the above-mentioned variables and jaw or neck pain.

Discussion

The main finding in the present study was that individuals with a recent whiplash trauma reported more psychosocial symptoms, as well as more jaw and neck pain and disability, compared to controls. The null hypothesis was thus refuted, since there were differences between cases and controls regarding the presence of pain in the jaw and neck regions and the severity of psychosocial factors and disability. Furthermore, for cases, psychosocial symptoms showed a correlation with jaw pain as well as with neck pain.

Psychosocial impairment can negatively affect a patient's oral health, as well as the prognosis and risk of chronicity with regard to pain complaints. A recent study highlighted the importance of psychosocial factors in health, reporting that the psychosocial aspects of pain had a contribution of more than 25% to dental patients' perceptions of their oral health.¹⁹ The limited number of studies that have investigated the impact of psychological comorbidities in patients suffering from acute orofacial pain report that psychosocial factors may help to predict pain severity and chronicity.^{20,21} As a consequence, assessment of psychosocial factors and pain-related disability has been advocated not only in chronic pain conditions but also in general dental practice and in dental education.^{22,23} For example, psychological characteristics may influence how a patient reacts to pain and how patients choose coping

strategies when in pain. Such coping strategies may be either helpful or harmful in terms of facilitating pain recovery. Pain, be it acute or chronic, may cause depression, anxiety, catastrophizing, and fear of movement, which can maintain and perpetuate pain and dysfunction. Thus, it has been suggested that psychologic risk factors are similar in acute and chronic pain conditions; for example, for both first-onset TMD (typically acute) and chronic TMD.²⁴

For chronic TMD, there is a range of studies available on the association between psychosocial factors and pain and disability. The importance of psychosocial factors was highlighted in a recent study on psychosocial impairment from somatic and depression symptoms in patients with TMD.⁹ Different studies on TMD populations show scores within the normal range,²⁵ as well as increased levels of physical symptoms and depression.²⁶ Higher scores for somatic symptoms and depression are also reported in other chronic pain conditions.⁴ In the present study, the controls were within the normal range for the general population, but half of the cases with a recent neck trauma were classified as moderate to severe with regard to the degree of somatic symptoms and depression. The finding of a higher degree of psychosocial symptoms in the case group is in line with other reports on the acute stage after whiplash trauma.²⁷ Thus, increased scores for somatic symptoms and depression have been reported within 1 month of whiplash injury in addition to the most common symptoms (neck pain and disability).²⁸

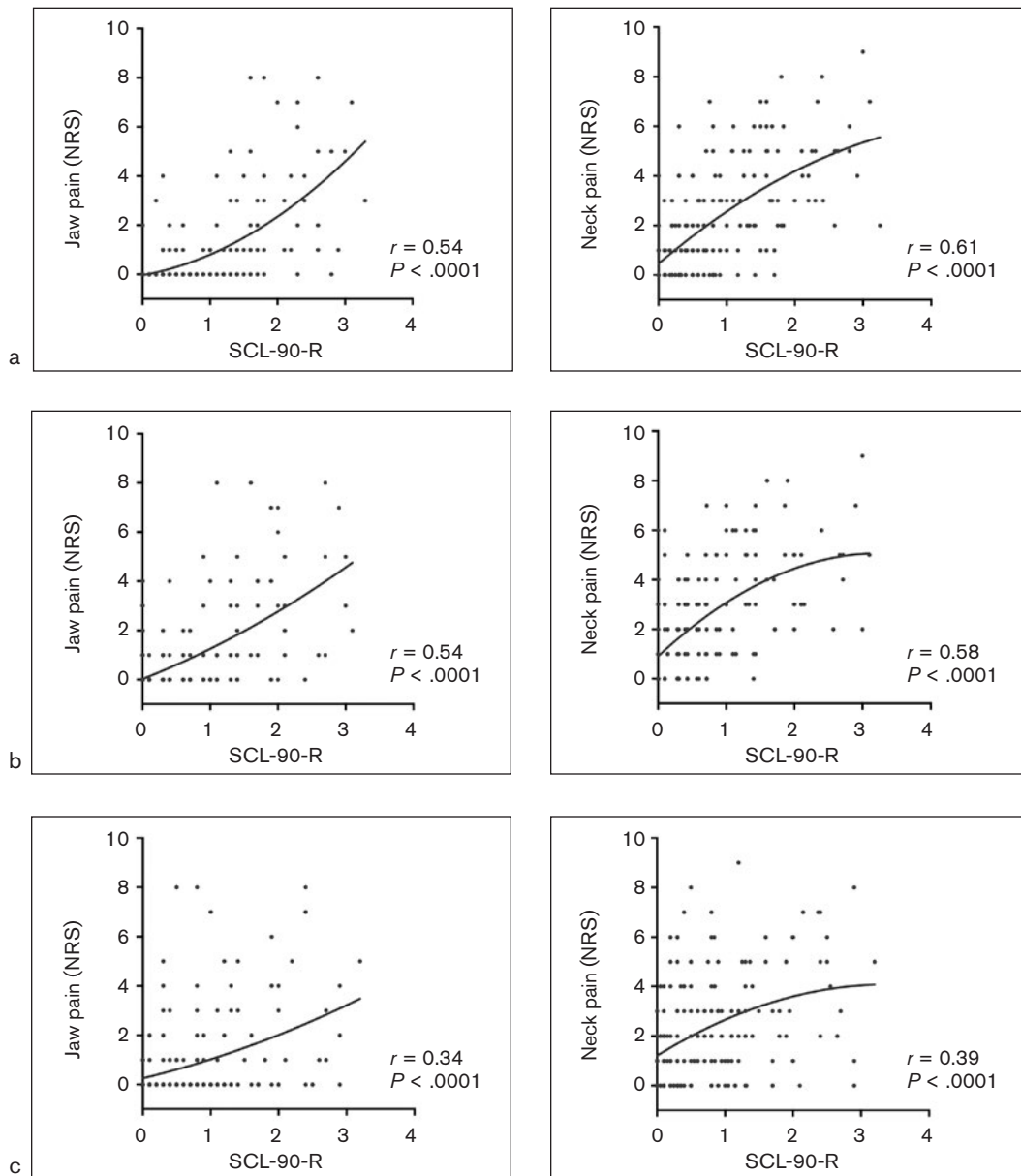


Fig 3 Scatterplots for (a) physical symptoms, (b) nonpain physical symptoms, and (c) depression reported by cases on the SCL-90-R scale (0–4) vs jaw pain and neck pain rated on a 0–10 numeric rating scale (NRS).

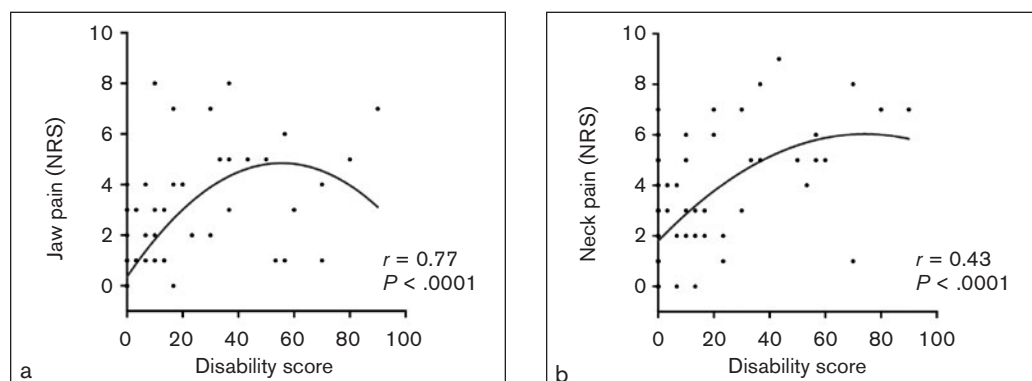


Fig 4 Scatterplot for jaw pain–related disability score (0–100) as reported by cases vs (a) jaw pain and (b) neck pain rated on a 0–10 numeric rating scale (NRS).

The firm correlations between the included psychosocial variables and the intensity of pain in both the jaw and neck regions, together with the pain-related disability in the jaw region, indicate that psychosocial symptoms and pain-related disability already exist in the acute stage after a whiplash trauma. It is not known, however, if these symptoms developed simultaneously as a consequence of the trauma or if some existed before the accident. Although the pain in the present study was assessed by the patient as either pain in the neck region or orofacial region (denoted as jaw pain), the associations between psychosocial factors and jaw pain, as well as neck pain, are nevertheless important, thus supporting that psychosocial factors may underlie, contribute, or interact bi-directionally with the development of chronic TMD.^{24,29,30}

Established instruments with good validity and reliability were used to measure the outcomes of the present study. A clinical examination was also carried out, but not analyzed as part of this cross-sectional study. The reason for this is an ongoing 2-year prospective study including a follow-up clinical examination, which will be analyzed and reported at a later stage. In order to keep the prospective study double-blind, the authors did not want the examiner (E.L.) or any of the involved researchers to know the outcome of the baseline clinical examination.

The pathophysiologic mechanisms of TMD after a neck trauma are unknown. However, these may be related to the close functional relationship between the jaw and neck regions; ie, the spread of pain between the jaw and neck regions could be linked to the close anatomical relationship of the trigeminal and cervical nucleus in the brain stem³¹ or by generalized pain caused by altered pain thresholds and pain modulation due to central sensitization mechanisms.³² Increased levels of psychosocial symptoms in the acute stage after a whiplash trauma were found in the present study, as well as a correlation between these psychosocial symptoms and both jaw pain and with neck pain. In addition, all these relationships had almost identical correlations with jaw pain and neck pain. This reinforces the close functional and neuroanatomical integration between the jaw and neck regions. These findings also indicate that TMD as a consequence of whiplash trauma is not an isolated pain in the orofacial area, but related to a general impact on a higher level. This is in line with the suggestions from Sterling et al that sensitization of the central nervous system occurs within 1 month following a whiplash injury and that this sensitization differentiates individuals with higher levels of pain and disability from those with lesser symptoms.²⁸ Taken together, these findings reinforce the concept of TMD after whiplash trauma as being related

to central mechanisms rather than to a local biomechanical explanation. This is indirectly supported by prospective studies showing no relationship between structural damage to the TMJ and TMD pain following whiplash trauma.^{33,34} Therefore it can be proposed that it is time to put to rest the notion of TMD pain following whiplash trauma as being mainly a local TMJ disc disorder.

Conclusions

Shortly after a whiplash trauma, jaw pain is associated not only with neck pain but also with the severity of psychosocial factors and pain-related disability. The increased levels of nonspecific physical symptoms, depression, and pain-related disability within 1 month following a whiplash trauma, together with the positive correlations of these factors with intensity of pain in both the jaw and neck regions, strengthen the suggestion that jaw pain may be a part of all aspects of WAD in the acute stage after trauma. The authors have also previously reported a positive correlation between intensity of jaw and neck pain shortly after a whiplash trauma,¹⁴ suggesting that intensity of neck pain could be a potential risk factor for development of chronic jaw pain and disability. The positive correlations of jaw pain and neck pain with psychosocial factors and pain-related disability within 1 month after a neck trauma observed in the present study suggest that psychosocial factors together with intensity of neck pain may be risk factors for development of jaw pain and dysfunction after whiplash trauma.

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