

Effect of Mental and Behavioral Factors on Severity of Disability following Whiplash Injury

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Abstract

Background: Chronic pain and disability after whiplash injury is common and causes considerable social and financial costs. Predicting the factors contributing to disability in whiplash injury can facilitate rapid intervention.

Objectives: The aim of this study was to examine the effect of mental and behavioral factors on severity of whiplash injury disability two years after the primary insult.

Methods: In this analytic cross-sectional study, chronic complications of whiplash injury in patients were evaluated two years after the insult. Participants were categorized into three groups based on neck disability index scores at 2 years after the injury. Inter-group differences were analyzed and investigated with previous inconsistencies. P values less than 0.05 were considered statistically significant.

Results: A total number of 81 patients were investigated in our study. Patients were categorized into the “recovered”, “mild pain and disability” and “moderate/severe pain and disability” groups. There was no statistically significant relationship between three groups regarding the treatment method. Our results showed a statistically significant difference between the personality type and severity of disability ($P = 0.031$). The Beck depression score was not significantly different between the three disability groups.

Conclusions: Type B personality and primary presence of moderate stress symptoms after trauma can predict strongly the poor outcome at 2 years after injury. These factors should be evaluated in people with acute whiplash injury. Appropriate treatment based on these factors may help to reduce chronicity and related complications.

Keywords: Mental, Behavioral, Severity, Whiplash

1. Background

Chronic pain and disability progression after whiplash injury is common and causes considerable social and financial costs (1). Predicting the factors contributing to disability in whiplash injury can facilitate rapid intervention. Prompt interventions are important for probable decrease of costs and long-term complications (2, 3).

Whiplash associated disorders (WAD) is a complex disease with disturbances in motor function, pain processing and mental distress (4, 5). In other words, this term is given for the collection of neck affecting symptoms that are triggered by whiplash injury. The Quebec task force classifies whiplash patients, based on the severity of signs and symptoms, as follows: Grade 0: No complaints about the neck and no physical sign (s). Grade I: Neck complaint of pain, stiffness or tenderness only and no physical sign (s). Grade II: Neck complaint and musculoskeletal sign

(s). Musculoskeletal signs included a decreased range of motion and point tenderness. Grade III: Neck complaint and neurological sign (s). Neurological signs included a decreased range of motion and point tenderness. Grade IV: Neck complaint and fracture or dislocation (6). Alterations are present just after the injury (7). These changes are possibly important in improvement or persistence of the symptoms. Postinjury sensory and motor disorders develop rapidly and linger in lack of robust healing (5). It is believed that mental factors in vertebral column injury can influence the transition from acute to chronic pain (8). This influence is not investigated in WAD efficiently (3).

Some people show complex symptoms after whiplash injuries (4). These symptoms include increase in central pain processing, loss of motor function and stress reaction following trauma (5). An independent prospective research can confirm these findings. In Jull et al.'s study, pain

tolerance did not improve one year after injury (9). It is not known if these factors persist and maintain predicting capacity in the long term (10).

2. Objectives

This study aimed to examine the effect of mental and behavioral factors on severity of whiplash injury disability two years after the primary insult.

3. Methods

This analytic cross-sectional study was conducted on all patients with the whiplash injury, according to our criteria, admitted to Poursina hospital in Rasht and Sina hospital in Tehran during 2010 - 2013. In this study, we evaluated the patients for chronic complications of the whiplash injury 2 years after the insult.

We included 87 patients who were complaining of neck pain following hyperextension in a motor vehicle crash. All patients received conservative treatment. Eighty-one patients were followed for 2 years after the injury. Six patients had not returned for follow-up. Participants were enrolled by the emergency and accidents department of Rasht Poursina and Tehran Sina hospitals, 39 and 42 patients, respectively. They were included if they met the Quebec task force classification of WAD II or III (11). Exclusion criteria were WAD IV, loss of consciousness and head trauma, and history of psychotic disorders. Also, we excluded patients who reported history of a previous neck pain, headache or another whiplash injury that needed treatment. All patients were given informed consent. This study was approved by the ethics committee.

3.1. Motor Function Physical Criteria

An active range of motion (ROM) was measured with an electromagnetic tracking device using an already established method (8, 12). Flexion, extension and left and right rotations were measured. Surface electromyography (EMG) was conducted to measure the activity of superficial neck flexor in a 5-stage test for cranio-cervical flexion (13).

3.2. Sensory Function Criteria

Pressure pain threshold (PPT) was measured bilaterally on C2/3 and C5/6 joints by pressure algometry with 1 cm² size probe and the rate of 40 kPa/s (14). Three copies of the records were taken at each site. The mean of these values were used for analysis.

3.3. Questionnaires

Neck disability index (NDI) investigates 10 items of personal care, lifting, reading, work, driving, sleeping, recreational activities, pain intensity, concentration and headache. Answers to each question ranges from no disability (0) to complete disability (5). Total score of 100 is calculated by multiplying the sum of all ten question scores by two. Higher scores indicate more pain and disability (15).

The TAMPTA scale of kinesiophobia (TSK) is a 17-item questionnaire that measures fear of movement/(re)injury (16).

The total score in the TSK ranges from 17 to 68. A high score on the TSK indicates a high degree of kinesiophobia, and a cut-off score was developed by Vlaeyen (1995), where scores of 37 or higher are considered as high scores, while scores below 37 are considered as low scores (16).

Impact of events scale (IES) is a 22-item questionnaire. This scale measures current subjective stress that is related to a specific life event. The IES-R was developed in 1997 by Daniel Weiss and Charles Marmar to reflect the Fourth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for posttraumatic stress disorder (PTSD) (17).

The IES-R was also designed to assess hyperarousal as well as other DSM criteria for PTSD. Other criteria included exposure to a traumatic event, duration of symptoms and impairment due to symptoms.

The hyperarousal scale adds new items to the original IES; items 4, 10, 15, 18, 19 and 21. These new items help measure hyperarousal symptoms, such as anger and irritability, heightened startle response, difficulty in concentrating and hypervigilance.

The maximum mean score on each of the three subscales is "4"; therefore, the maximum 'total mean' IES-R score is 12. Lower scores are better. A total IES-R score of 33 or over from a theoretical maximum of 88 signifies the likely presence of PTSD.

3.4. Beck Depression Questionnaire

This 21-item questionnaire is made for evaluating symptoms and feedbacks of depressed patients. The Beck depression questionnaire (17) is a self-assessment test that can be completed in 5 to 10 minutes. Each question is scored from 0 to 4. 21 Items are in different depression related fields such as sadness, pessimism, disability and feelings of failure or guilt, sleep disturbances, loss of appetite self-hatred, etc. This questionnaire determines the presence and degree of depression from mild to severe. Total score is based on following categorization:

0 - 13: no or minimal depression

- 14 - 19: mild depression
 20 - 28: moderate depression
 29 - 63 severe depression

3.5. State-Trait Anxiety Inventory

The state-trait anxiety inventory (STAI) is designed for self-administering purposes. This inventory can be used in an individual or group fashion. The Spielberger anxiety questionnaire is composed of two scales of situational and personality related anxiety. This test contains 40 short questions regulated in positive or negative form. Each question is scored from very little (1) to very much (4). The range of total possible score is from 20 to 80 (18).

3.6. Personality Type Questionnaire

Regarding personality, everyone is related to type A or B. Type A people show qualities like despotism, sensitivity, worry, great need of progression, aggressiveness, competitiveness, proactivity, impatience, quarrelsomeness, etc. Psychologists describe type A people as complex sensitive people that are usually in an offensive mood and quarrel and confront other people and factors to gain success. In contrary, type B people are calm, patient and temperate.

Patients' behavior was measured by the Bortner scale (1969). This 14 item-scale is widely used in psychology and health sciences to distinguish type A and B personalities. Previous researches showed good reliability, structural validity (Bortner, 1969) and predictive validity (Jamal, 1990). Total scores of 84 or higher and 14 to 83 shows type A and type B personality, respectively.

3.7. Implementation Process

All tests were conducted in the same lab setting and by a similar test giver. (MS) Primarily, in first month after the injury, questionnaires of the Spielberger anxiety, Beck depression, personality type and the TAMPTA scale of kinesiophobia were completed. At the end of the investigation period, the neck disability index (NDI) and impact of events scale (IES) were completed (13).

3.8. Data Analysis

Participants were categorized into 3 groups based on the NDI scores at 2 years after the injury. These groups were recovered (less than 8), mild pain and disability (10 - 28) and moderate/severe pain and disability (more than 30). Age and sex were used as accessory variables in this analysis. Intergroup differences were analyzed and investigated with previous inconsistencies. All data were entered into statistical package for the social science (SPSS) version

20.0 for analysis. The t-test was used for statistical analysis of parameters with normal distribution and the Mann-Whitney test was used for parameters with non-normal distributions. P values less than 0.05 were considered statistically significant.

4. Results

A total number of 81 patients were investigated in our study. All included patients met the Quebec task force classification of WAD II or III. There were 52 males (64.2%) and 29 females (35.8%) among them. Based on the NDI score, 31 (38.3%), 37 (45.7%) and 13 (16%) patients were in the "recovered", "mild pain and disability" and "moderate/severe pain and disability" groups, respectively (Figure 1).

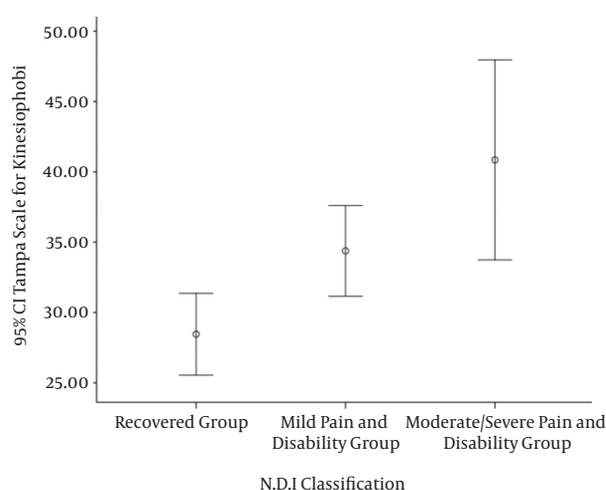


Figure 1. Patients' Distribution Based on the Neck Disability Index Score

The mean age of the patients was 39.76 ± 11.21 years old. Mean neck ranges of motion in right rotation, left rotation, flexion and extension were 50.92 ± 9.36 , 59.32 ± 6.31 , 44.53 ± 5.51 , 44.83 ± 7.46 , respectively. Table 1 shows a mean neck range of motion in each category of neck disability. There was a significant relationship between all 4 movement types, including left rotation, right rotation, extension and flexion ($P = 0.0001$, $P = 0.023$, $P = 0.0001$ and $P = 0.0001$, respectively). Table 2 shows the relation between neck movements categorized by 3 groups of disability. Based on this table, there was a statistically significant difference in right rotation movement in the recovered group compared to the moderate/severe pain and disability group ($P = 0.023$). Also, there was a statistically significant difference in left rotation and flexion movements between the moderate/severe pain and disability group compared to the recovered and mild pain and disability groups

($P = 0.0001$). In extension movement, all 3 disability groups in relation to each other had statistically significant differences (the recovered group compared to the moderate/severe pain and disability group ($P = 0.001$), the moderate/severe pain and disability compared to the mild pain and disability ($P = 0.0001$) and the recovered group compared to the mild pain and disability group ($P = 0.0001$).

Table 3 shows EMG, PPT Tib, PPT Median nerve and PPT neck categorized by 3 groups of disability. There was a significant difference between the three groups regarding the above-mentioned criteria. (P value = 0.0001). Based on data, There is a statistically significant difference in the moderate/severe pain and disability group compared to two other groups ($P = 0.0001$); however, there was no statistically significant difference between the recovered and mild pain/disability groups ($P = 0.314, 0.178$ and 0.985 , respectively).

Treatment methods in the three groups of disability are presented. Most patients (45 cases) needed no treatment and 32 cases received physiotherapy. There was no statistically significant relationship between the three groups regarding the treatment method ($P = 0.624$). Chart 1 shows that most of the patients (50 cases) did not receive any treatment. Among 31 patients who received drug treatment, the most commonly used medications were NSAIDs. There was a statistically significant relationship between administered medications in 17 patients among the three groups of disability ($P = 0.031$).

Data shows implicit and explicit Spielberger anxiety in the three groups of disability. There was no significant relationship between three disability groups ($P = 0.785$ and 0.898 in explicit and implicit anxiety, respectively). Results showed no significant difference in the Beck depression score between the three disability groups ($P = 0.214$). Results also showed a statistically significant difference between the personality type and severity of disability ($P = 0.031$). Moreover, 52.9% and 19.6% of the patients with type b personality were in the mild pain and disability and moderate/severe pain and disability groups, respectively. Among type "A" patients, 56.6% were in the recovered group and only 10% were in the moderate/severe pain and disability group.

Mean score of fear of movement/(re)injury by the TAMPA scale of kinesiophobia was 10.26 ± 33.14 . There was a statistically significant difference between the three disability groups. Chart 2 shows that patients in the recovered group were significantly different from two other groups ($P = 0.03$ and 0.0001 in comparison to the mild pain and disability and moderate/sever pain and disability groups, respectively).

Mean score of the current subjective stress by the impact of events scale (IES) was 6.58 ± 1.73 . Scores of avoid-

ance, intrusion and hyperarousal parts of this scale were 2.11 ± 0.85 , 2.31 ± 0.85 and 2.15 ± 0.88 , respectively. There was a statistically significant difference between the three disability groups.

5. Discussion

Little is known about whiplash acute injury transition to improvement or chronicity and chronic WAD development. Current assumptions are altered central pain processing/ central sensitivity (12-15), role of changed stress response and some cognitive and behavioral factors, such as disaster and fear avoidance (10, 16-18). There is a close relation between stress response, cognition, behaviors and central sensitivity (described as cognitive emotional sensitivity). Regarding this relation, it seems that all these factors are parts of a biopsychosocial puzzle. There is increasing international belief that whiplash shows a biopsychosocial problem (1, 10, 11, 17, 19).

In a study, Sterling and colleagues showed that in 2 to 3 years after injury, most whiplash complications lingered in patients with moderate/severe symptoms. Long-term persistence of these complex presentations in this group shows the necessity of whiplash primary management. In this study, mental and physical disorders were evident one month after the injury and remained for 2 - 3 years without change. It has been shown that injured patients in whiplash may need early primary multidisciplinary management to prevent chronicity of symptoms. This approach includes appropriate pain control (pharmacologic intervention), rehabilitation for motor disorders (physiotherapy) and cognitive and behavioral management of mental disturbances (20).

Our findings on persistence of injury related changes show the necessity of suitable early and effective interventions that are directed toward these disorders. This kind of intervention may decrease whiplash chronic complications. In order to answer this question, we investigated 5 criterion of fear of movement/(re)injury, post-trauma stress, implicit and explicit anxiety, depression and personality type.

Fear-avoidance beliefs are described as important cognitive factor for predicting disability of back pain (21). However, the role of these beliefs in WAD is still questionable. Despite lack of comprehensive information, it's suggested that fear-avoidance beliefs play a paramount role in pain and disability in whiplash patients (22). This suggestion needs further investigations, and our study attempted to further investigate this problem. In our study, both groups of mild and moderate/severe disability got high TSK scores at the beginning of the study (less than one month after the injury). These scores were similar to

Table 1. The Mean Neck Range of Motion in Each Category of Neck Disability

Dependent Variable	(I) N.D.I Classification	(J) N.D.I Classification	Mean Difference (I - J)	P Value ^a
Right rotation	Recovered group	Mild Pain and disability group	- 5.83871	0.026
		Moderate/ severe pain and disability group	- 0.60794	0.977
	Mild Pain and disability group	Moderate/ severe pain and disability group	5.83871	0.026
			5.23077	0.178
	Moderate/ severe pain and disability group	Recovered group	0.60794	0.977
		Mild pain and disability group	- 5.23077	0.178
Left rotation	Recovered group	Mild pain and disability group	- 1.66957	0.411
		Moderate/ Severe pain and disability group	8.17866	0.000
	Mild pain and disability group	Recovered group	1.66957	0.411
		Moderate/ Severe pain and disability group	9.84823	0.000
	Moderate/ Severe pain and disability group	Recovered group	- 8.17866	0.000
		Mild pain and disability group	9.84823	0.000
Flexion	Recovery group	Mild pain and disability group	- 1.75240	0.184
		Moderate/ Severe pain and disability group	9.11663	0.000
	Mild pain and disability group	Recovered group	1.75240	0.184
		Moderate pain and disability group	10.86902	0.000
	Moderate/ Severe pain and disability group	Recovered group	- 9.11663	0.000
		Mild pain and disability group	- 10.86902	0.000
Extension	Recovered group	Mild pain and disability group	- 10.44813	0.000
		Moderate/ Severe pain and disability group	5.21092	0.001
	Mild pain and disability group	Recovered group	10.44813	0.000
		Moderate/ Severe pain and disability group	15.65904	0.000
	Moderate/ Severe pain and disability group	Recovered group	- 5.21092	0.001
		Mild pain and disability group	- 15.65904	0.000

^aP < 0.05 is considered significant.

those reported for chronic back pain (23). Fear of movement/(re)injury in the acute injury phase can be considered a mechanism against re-injuries (16).

The results of the current study showed that the mean score of current subjective stress in patients with more disability is higher. Our study findings are similar to findings of Drottning and colleagues in 1995 (24). They showed higher IES scores in acutely injured patients with higher pain level. That research follows whiplash patients only 4 weeks after the injury in the acute phase, but the results of our study showed that stress reaction after the accident would remain in the chronic phase, too.

Investigation of mental factors show that mental disturbance in WAD chronic phase is possibly due to disability and persistent pain (25, 26). We tried to investigate the

role of anxiety and depression in exacerbation of whiplash related disability by evaluating the level of anxiety and depression at the beginning.

Gargan et al. (1997) showed that mental disturbance one week after the injury is increased in relation to limited neck movements (27). This view is supported by other prospective studies, as well. It has been reported that recovery after whiplash can be predicted by severity of the injury and not personality traits or self-rated health (26). A large cross-sectional study showed a relation between anxiety and depression with pain and disability in patients who had whiplash injuries more than 2 years ago; however, this relation was not seen in acute whiplash patients. This finding showed that persistence of symptoms is a stimulus for mental disturbance (28). Our study showed that the pa-

Table 2. The Relation Between Neck Movements Categorized by Three Groups of Disability

		N	Mean	Std. Deviation	Minimum	Maximum
EMG	Recovered group	31	19.1290	7.10747	2.00	38.00
	Mild pain and disability group	37	16.4595	6.72720	5.00	25.00
	Moderate/ severe pain and disability group	13	40.7692	10.14194	29.00	60.00
	Total	81	21.3827	11.35734	2.00	60.00
PPT neck	Recovered group	31	204.0645	26.56933	125.00	275.00
	Mild pain and disability group	37	192.6216	24.66143	115.00	250.00
	Moderate/ severe pain and disability group	13	127.9231	29.51401	70.00	190.00
	Total	81	186.6173	36.92579	70.00	275.00
PPT median nerve	Recovered group	31	208.4839	28.17430	170.00	300.00
	Mild pain and disability group	37	261.9730	37.73334	170.00	360.00
	Moderate/ severe pain and disability group	13	155.6154	29.81292	125.00	195.00
	Total	81	50.90799	50.90799	125.00	360.00
PPT Tibial anterior nerve	Recovered group	31	409.5161	54.13494	280.00	565.00
	Mild pain and disability group	37	407.1622	69.93589	255.00	555.00
	Moderate/ severe pain and disability group	13	297.3846	20.69436	260.00	345.00
	Total	81	390.4444	71.00458	255.00	565.00

Abbreviations: EMG, electromyography; PPT, pressure pain threshold.

tients' anxiety and depression level does not predict severity of disability after 2 years, but the personality type is a predicting risk factor.

Three longitudinal studies did not find any relation between personality and long-term function (14, 24, 25); however, two other studies had opposite results. In one of these studies, personality disorders were reported in 30% of the WAD patients (27). In the second study, it was concluded that personality affects the quality of life and cognitive functions in WAD patients (29). Our study adds the evidences supporting the role of personality types of A and B in long-term function after the whiplash injury. The results of the current study showed type B patients had a higher level of disability. Different results about the personality role in different studies can be due to various criteria for evaluating the personality.

In summary, we showed that patients with poor outcome following the whiplash injury have presented motor and mental disorders right after the injury. These disorders continue to persist in chronic period. These qualities show that an underlying complex mechanism serves as a facilitating factor in moderate/severe symptoms after whiplash injuries. These mechanisms include central pain process-

ing, posttraumatic stress and motor disorders. Type B personality and primary presence of moderate stress symptoms after trauma can strongly predict the poor outcome at 2 years after the injury. These factors should be evaluated in people with acute whiplash injury. Appropriate treatment based on these factors may help to reduce chronicity and related complications.

Table 3. Electromyography, Pressure Pain Threshold Neck, Median Nerve and Tibial Anterior Nerve

Dependent Variable	(I) N.D.I Classification	(J) N.D.I Classification	Mean Difference	P Value ^a
EMG	Recovered group	Mild pain and disability group	2.66957	0.314
		Moderate/ severe pain and disability group	-21.64020	0.000
	Mild pain and disability group	Recovered group	-2.66957	0.314
		Moderate/ severe pain and disability group	-24.30977	0.000
	Moderate/ severe pain and disability group	Recovered group	21.64020	0.000
		Mild pain and disability	24.30977	0.000
PPT neck	Recovered group	Mild pain and disability group	11.44289	0.178
		Moderate/ severe pain and disability group	76.14144	0.000
	Mild pain and disability group	Recovered group	-11.44289	0.178
		Moderate/ severe pain and disability group	64.69854	0.000
	Moderate/ severe pain and disability group	Recovered group	-76/14144	0.000
		Mild pain and disability group	-64.69854	0.000
PPT median nerve	Recovered group	Mild pain and disability group	-53.48910	0.000
		Moderate/ severe pain and disability group	52.86849	0.000
	Mild pain and disability group	Recovered group	53.48910	0.000
		Moderate/ severe pain and disability group	106.35759	0.000
	Moderate/ severe pain and disability group	Recovered pain	-52.86849	0.000
		Mild pain and disability group	-106.35759	0.000
PPT tibial anterior nerve	Recovered group	Mild pain and disability group	2.35397	0.985
		Moderate/ severe pain and disability group	112.13151	0.000
	Mild pain and disability group	Recovered group	-2.35397	0.985
		Moderate/ severe pain and disability group	109.77755	0.000
	Moderate/ severe pain and disability group	Recovered group	-112.13151	0.000
		Mild pain and disability group	-109.77755	0.000

^aP < 0.05 is considered significant.

References

- Barnsley L, Lord S, Bogduk N. Whiplash injury. *Pain*. 1994;**58**(3):283-307. [PubMed: 7838578].
- Cassidy JD, Carroll LJ, Cote P, Lemstra M, Berglund A, Nygren A. Effect of eliminating compensation for pain and suffering on the outcome of insurance claims for whiplash injury. *N Engl J Med*. 2000;**342**(16):1179-86. doi: 10.1056/NEJM200004203421606. [PubMed: 10770984].
- Clarkson HM. Musculoskeletal assessment: joint range of motion and manual muscle strength. Lippincott Williams & Wilkins; 2000.
- Cote P, Cassidy JD, Carroll L, Frank JW, Bombardier C. A systematic review of the prognosis of acute whiplash and a new conceptual framework to synthesize the literature. *Spine (Phila Pa 1976)*. 2001;**26**(19):E445-58. [PubMed: 11698904].
- Goldberg D. Manual of the general health questionnaire. NFER Nelson; 1978.
- Pastakia K, Kumar S. Acute whiplash associated disorders (WAD). *Open Access Emerg Med*. 2011;**3**:29-32. doi: 10.2147/OAEM.S17853. [PubMed: 27147849].
- Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine (Phila Pa 1976)*. 2001;**26**(11):E243-8. [PubMed: 11389408].
- Horowitz M, Wilner N, Alvarez W. Impact of Event Scale: a measure of subjective stress. *Psychosom Med*. 1979;**41**(3):209-18. [PubMed: 472086].
- Jull G, Kristjansson E, Dall'Alba P. Impairment in the cervical flexors: a comparison of whiplash and insidious onset neck pain patients. *Man Ther*. 2004;**9**(2):89-94. doi: 10.1016/S1356-689X(03)00086-9. [PubMed: 15040968].
- Kasch H, Bach FW, Jensen TS. Handicap after acute whiplash injury: a 1-year prospective study of risk factors. *Neurology*. 2001;**56**(12):1637-43. [PubMed: 11425927].
- Spitzer WO, Skovron ML, Salmi LR, Cassidy JD, Duranceau J, Suissa S, et al. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining "whiplash" and its management. *Spine (Phila Pa 1976)*. 1995;**20**(8 Suppl):1S-73S. [PubMed: 7604354].
- Kasch H, Qerama E, Bach FW, Jensen TS. Reduced cold pressor pain tolerance in non-recovered whiplash patients: a 1-year prospective study. *Eur J Pain*. 2005;**9**(5):561-9. doi: 10.1016/j.ejpain.2004.11.011. [PubMed: 16139185].

13. Kori SH, Miller RP, Todd DD. Kinesiophobia: a new view of chronic pain behavior. *Pain Manag*. 1990;**3**(1):35-43.
14. Radanov BP, Sturzenegger M, Di Stefano G. Long-term outcome after whiplash injury. A 2-year follow-up considering features of injury mechanism and somatic, radiologic, and psychosocial findings. *Medicine (Baltimore)*. 1995;**74**(5):281-97. [PubMed: [7565068](#)].
15. Scholten-Peeters GG, Verhagen AP, Bekkering GE, van der Windt DA, Barnsley L, Oostendorp RA, et al. Prognostic factors of whiplash-associated disorders: a systematic review of prospective cohort studies. *Pain*. 2003;**104**(1-2):303-22. [PubMed: [12855341](#)].
16. Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. *Pain*. 1995;**62**(3):363-72. [PubMed: [8657437](#)].
17. Zatzick DF, Marmar CR, Weiss DS, Browner WS, Metzler TJ, Golding JM, et al. Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. *Am J Psychiatry*. 1997;**154**(12):1690-5. doi: [10.1176/ajp.154.12.1690](#). [PubMed: [9396947](#)].
18. Fathi-Ashtiani A, Dastani M. Psychological tests: Personality and mental health. *Tehran: Be'sat Publication Institute*. 2009:291-308.
19. Schurmann M, Gradl G, Andress HJ, Furst H, Schildberg FW. Assessment of peripheral sympathetic nervous function for diagnosing early post-traumatic complex regional pain syndrome type I. *Pain*. 1999;**80**(1-2):149-59. [PubMed: [10204727](#)].
20. Sterling M. A proposed new classification system for whiplash associated disorders-implications for assessment and management. *Man Ther*. 2004;**9**(2):60-70. doi: [10.1016/j.math.2004.01.006](#). [PubMed: [15040964](#)].
21. Sterling M, Jull G, Vicenzino B, Kenardy J. Sensory hypersensitivity occurs soon after whiplash injury and is associated with poor recovery. *Pain*. 2003;**104**(3):509-17. [PubMed: [12927623](#)].
22. Sterling M, Jull G, Vicenzino B, Kenardy J, Darnell R. Development of motor system dysfunction following whiplash injury. *Pain*. 2003;**103**(1-2):65-73. [PubMed: [12749960](#)].
23. Sterling M, Kenardy J, Jull G, Vicenzino B. The development of psychological changes following whiplash injury. *Pain*. 2003;**106**(3):481-9. [PubMed: [14659532](#)].
24. Drottning M, Staff PH, Levin L, Malt UF. Acute emotional response to common whiplash predicts subsequent pain complaints: a prospective study of 107 subjects sustaining whiplash injury. *Nord J Psychiatry*. 1995;**49**(4):293-300.
25. Klenerman L, Slade PD, Stanley IM, Pennie B, Reilly JP, Atchison LE, et al. The prediction of chronicity in patients with an acute attack of low back pain in a general practice setting. *Spine (Phila Pa 1976)*. 1995;**20**(4):478-84. [PubMed: [7747233](#)].
26. Nederhand MJ, Hermens HJ, I. Jzerman MJ, Turk DC, Zilvold G. Cervical muscle dysfunction in chronic whiplash-associated disorder grade 2: the relevance of the trauma. *Spine (Phila Pa 1976)*. 2002;**27**(10):1056-61. [PubMed: [12004172](#)].
27. Gargan M, Bannister G, Main C, Hollis S. The behavioural response to whiplash injury. *J Bone Joint Surg Br*. 1997;**79**(4):523-6. [PubMed: [9250729](#)].
28. Crombez G, Vlaeyen JW, Heuts PH, Lysens R. Pain-related fear is more disabling than pain itself: evidence on the role of pain-related fear in chronic back pain disability. *Pain*. 1999;**80**(1-2):329-39. [PubMed: [10204746](#)].
29. Wenzel HG, Haug TT, Mykletun A, Dahl AA. A population study of anxiety and depression among persons who report whiplash traumas. *J Psychosom Res*. 2002;**53**(3):831-5. [PubMed: [12217459](#)].