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Research

Sleep Characteristics in Patients with Whiplash-Associated Disorders: A Descriptive Study

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Abstract

Study Objectives: The purpose of this study was to explore sleep habits and characteristics of patients with whiplash-associated disorders (WAD) presenting at an outpatient, chiropractic clinic using the Medical Outcomes Study (MOS) Sleep Scale.

Methods: Fifty-one patients from an outpatient chiropractic and physical therapy clinic specializing in spinal rehabilitation participated in this cross-sectional, descriptive study. Data were collected using a descriptive survey, the Visual Analog Scale (VAS), the Neck Disability Index (NDI), and the self-administered 12-item MOS Sleep Scale. Data analysis included descriptive statistics to describe pain, disability, and sleep characteristics of the study sample, and computation of confidence intervals to determine differences in means of sleep characteristics between the non-WAD population (as determined by previous studies) and the study sample of WAD patients.

Results: Results indicate that when compared to normative values of the non-WAD population, the sample of WAD patients in this study presents with significantly greater measures of neck disability (NDI), neck pain (VAS), sleep disturbance, snoring, shortness of breath and headache,

sleep somnolence and sleep problems index I and II. This sample also presents with significantly lower measures of optimal sleep when compared to the general population.

Conclusion: Consistent with previous research, findings from this study indicate that WAD patients have increased neck disability and pain, and poorer sleep outcomes, indicating the need for clinicians to assess sleep characteristics and incorporate interventions aimed at alleviating these symptoms when planning rehabilitation. Findings provide evidence for the need to further explore sleep disturbances among WAD patients to establish a stronger understanding of the course and prognosis of this condition.

Introduction

Neck pain related to whiplash-associated disorders (WAD) constitutes a significant health issue that leads patients to seek medical care in chiropractic and other physical therapy, rehabilitative clinics. Studies have indicated that individuals experience multiple clinical manifestations of WADs that lead to chronicity including postural changes, disability, headache, fatigue, and sleep disturbances.[1-4] Although studies have shown that sleep disturbances occur as a result of chronic pain, few studies have explored the relationship between patients with WAD and sleep quality.[4-6]

Sleep disturbances that commonly occur during the initial period following the whiplash injury include delayed sleep latency and poor sleep quality.[4] Symptoms such as neck pain and tension headaches related to WAD are known to worsen with extended periods of poor posture, such as during night-time sleeping, causing significant sleep disturbances.[7, 8] Alteration in sleep quality in patients with WAD also leads to poor prognosis and increased chronicity of the condition. In a prospective cohort study by Hendriks et al. factors related to poor recovery in patients with WAD included higher levels of somatization and sleep difficulties.[9] Additionally, in a comparative study exploring sleep quality in patients with mechanical insidious neck pain and whiplash-associated neck pain, Valenza et al. found that individuals experiencing the latter showed poorer sleep quality.[3] Results also indicated significant differences in sleep quality, sleep latency, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction among WAD patients when compared to healthy controls.[3] Several studies have indicated that the use of neck support devices, such as cervical pillows for sleep, can lead to improved posture, reduce cervical pain, while consequently improving sleep quality and WAD outcomes. [10-13] Therefore, improving sleep quality through the use of supportive therapies may have an impact on alleviating WAD symptoms and improved prognosis of the condition. This provides evidence for the need for chiropractic management of chronic WAD symptoms, with an emphasis on addressing pain and sleep disturbances as part of the evaluation and treatment of patients with WAD neck pain. However, limited literature regarding the characteristics and quality of sleep among WAD patients in relation to chiropractic health and management of chronic WAD symptoms warrants the need for further research.[2-4] Therefore, the purpose of this cross-sectional, descriptive study was to explore sleep habits and characteristics of patients with WAD presenting at an outpatient, chiropractic clinic using the MOS Sleep Scale.

Methods

Sample

In this cross-sectional, descriptive study, a convenience sample consisting of 51 patients were recruited from an outpatient chiropractic and physical therapy clinic specializing in spinal rehabilitation. Prior to data collection, the study was explained to interested individuals by a member of the research staff, and informed consent was obtained. Inclusion criteria were involvement in a MVA at any period before inclusion; presentation to the clinic for treatment of injuries sustained from accident; diagnoses of cervical spine pain, with or without radiculopathy; and, ages between 18 to 65 years. Additionally, a diagnosis of WAD was established by clear causation between trauma associated from the MVA and subsequent cervical spine symptomatology based on history and examination of the research participants. Participants were included in the study only if their conditions were amenable to treatment with nonsurgical approaches during the initial stages of management. Exclusion criteria are diagnoses which were not deemed to be appropriate for conservative management by patient's physician. This study was approved by the University of Louisville, Institutional Review Board (IRB#10.0199).

Data Collection

Several determinants and variables related to WAD and sleep outcomes were evaluated using a descriptive survey, the Visual Analog Scale (VAS), the Neck Disability Index (NDI), and the self-administered 12-item MOS Sleep Scale. After obtaining written informed consents, each research participant received these questionnaires that were completed at the outpatient clinic. The 0-10 VAS Pain Score is commonly used in clinical practice to identify pain severity and measured severity of neck pain in this study.[14] At each point in data collection, subjects responded to the question "On a scale of 1 to 10 how much neck pain are you experiencing right now, with 1 being 'no pain' and 10 being the 'worst pain imaginable'?" The NDI measured how patients perceive their performance of activities of daily living. The NDI has been the gold standard for evaluating disability in patients with neck injuries.[15] Scores on the NDI range from 0 to 100 with higher numbers indicating greater disability.

The MOS Sleep Scale measured sleep quantity and quality, sleeping habits, and waking and daytime symptoms occurring during a four week period prior to completing the questionnaire.[16] The MOS-sleep questionnaire has been shown to be reliable and valid in evaluating various conditions causing sleep disturbances[17,18] The MOS-sleep questionnaire was specifically used to measure shortness of breath, headaches, sleep somnolence, sleep problems, sleep disturbances, sleep adequacy, sleep duration, and snoring.[16] In addition, overall sleep problems were measured using two summary index measure scores: *Sleep Problem Index I* and *Sleep Problem Index II. Sleep Problem Index I* provides a brief summation index of variables including awakening with shortness of breath or headache; trouble staying awake during the day; trouble falling asleep; awakening during sleep and having trouble falling back asleep; getting enough sleep to feel rested in the morning; and, getting the adequate amount of sleep needed. *Sleep Problem Index II* represents a more comprehensive summation index that incorporates all items in Index I as well as: time taken to fall asleep; sleep not quiet; and, sleepiness or drowsiness during the day. Once each participant had completed the MOS-sleep questionnaire, all original numbers were calculated to obtain a percentage. All subscales and index measure were scored on a transformed 0-100 metric, with higher scores on these two indices indicating more sleep problems and poorer sleep quality.[19, 20]

Data Analysis

Data analysis to address the purpose was conducted in three phases. First, descriptive statistics (frequencies, means, standard deviations, correlations etc.) were calculated to describe the pain, disability and sleep characteristics of study sample with WAD **(See Table 1)**. Second, confidence intervals were computed to determine if the mean of non-WAD population (derived from general population samples from previous studies) was within the 95% confidence interval. represented by the sample of WAD patients. This statistic compared the sample of WAD patients with non-WAD patients on measures of neck disability, pain and sleep characteristics **(See Table 2)**. Finally, male and female WAD patients were compared on measures of disability, pain and sleep characteristics using independent t-tests **(See Table 3)**. All inferential statistics employed $p<.05$ as the level of statistical significance.

Table 1. Correlations with number of visits, days since onset, initial neck disability index and Pain (VAS)

		Number of Visits	Days Since Onset of Symptoms	NDI	VAS for pain
Number of Visits	Pearson Correlation	1	.034	.253	-.112
	p value (2-tailed)		.828	.102	.476
Age	Pearson Correlation	.014	-.269	.228	.046
	p value (2-tailed)	.927	.056	.108	.749
Days Since Onset of Symptoms	Pearson Correlation	.034	1	-.156	-.198
	p value (2-tailed)	.828		.275	.163
NDI	Pearson Correlation	.253	-.156	1	.239
	p value (2-tailed)	.102	.275		.092
VAS	Pearson Correlation	-.112	-.198	.239	1
	p value (2-tailed)	.476	.163	.092	
MOS Sleep Scale Total	Pearson Correlation	.007	.200	.175	.200
	p value (2-tailed)	.963	.159	.220	.159
Sleep Quantity (raw score)	Pearson Correlation	-.179	.163	-.128	.160
	p value (2-tailed)	.251	.252	.372	.261
Optimal sleep (dichotomy)	Pearson Correlation	.021	.179	.086	.163
	p value (2-tailed)	.891	.209	.550	.252
Sleep Disturbance	Pearson Correlation	-.037	.129	.070	.188
	p value (2-tailed)	.813	.368	.626	.186

Snoring	Pearson Correlation	.204	-.160	.236	.072
	p value (2-tailed)	.189	.262	.096	.617
Sleep Short of Breath or Headache	Pearson Correlation	-.031	.242	.257	.111
	p value (2-tailed)	.844	.087	.069	.439
Sleep Adequacy	Pearson Correlation	.122	.173	.132	.004
	p value (2-tailed)	.437	.224	.354	.978
Sleep Somnolence	Pearson Correlation	-.091	.219	.089	.179
	p value (2-tailed)	.565	.126	.537	.214
Sleep Problems Index I	Pearson Correlation	.038	.257	.157	.106
	p value (2-tailed)	.810	.068	.272	.457
Sleep Problems Index II	Pearson Correlation	-.014	.212	.164	.164
	p value (2-tailed)	.928	.135	.251	.249

Table 2. Comparing WAD with Non WAD individuals

	N	Minimum	Maximum	Mean	Std. Deviation	Normal values	95% Confidence Interval
NDI (%)	51	18	74	43.92	12.20	6.98[1]	40.52 – 47.32*
VAS for pain	51	4	10	7.76	1.41	0	7.36 – 8.15*
MOS Sleep Scale Total	51	2	82	48.63	17.77	45.96	43.68 – 53.58
Sleep Quantity (raw score)	51	2	10	5.63	1.73	6.93[3]	5.15 – 6.11
Optimal Sleep (dichotomy)	51	0	1	.25	.44	.54[3]	0.13 – 0.37*
Sleep Disturbance	51	.00	100	54.54	25.74	24.47[2]	47.37 - 61.71*
Snoring	51	0	100	41.18	34.50	28.33[2]	31.57 – 50.79*
Sleep Short of Breath or Headache	51	0	100	20.78	26.82	9.45[2]	13.31 – 28.25*

Sleep Adequacy	51	0	100	67.25	25.85	60.47[2]	60.05 – 74.45
Sleep Somnolence	50	.00	100	39.46	24.68	21.89[2]	32.57 – 46.33*
Sleep Problems Index I	51	0	80	47.78	18.44	25.79[2]	42.64 – 52.92*
Sleep Problems Index II	51	2.80	86.60	50.76	18.74	25.79[2]	45.54 – 55.98*

Note: [1] Kato et al, 2012; [2] Hays, Martin, Sesti, Spritzer, 2005; [3] Spritzer & Hays, 2003.
*Indicates the 95% CI does not include the mean of the general (non-WAD) population

Table 3. Comparing male and female WAD patients

		N	Mean	Std. Deviation	t-statistic	df	P<
Age	Female	30	40.53	12.204	1.358	49	.181
	Male	21	35.71	12.846			
MOS Sleep Scale Total	Female	30	52.15	15.284	1.725	49	.091
	Male	21	43.60	20.140			
Sleep Quantity (raw score)	Female	30	5.45	1.821	-.874	49	.386
	Male	21	5.88	1.596			
Optimal Sleep (dichotomy)	Female	30	.23	.430	-.415	49	.680
	Male	21	.29	.463			
Sleep Disturbance	Female	30	60.71	24.424	2.115	49	.040
	Male	21	45.73	25.557			
Snoring	Female	30	40.00	33.631	-.288	49	.774
	Male	21	42.86	36.489			
Sleep Short of Breath or Headache	Female	30	25.33	23.450	1.464	49	.150
	Male	21	14.29	30.426			
Sleep Adequacy	Female	30	68.67	25.152	.462	49	.646
	Male	21	65.24	27.316			
Sleep Somnolence	Female	29	43.67	23.201	1.434	48	.158
	Male	21	33.64	26.029			

Sleep Problems Index I	Female	30	52.13	16.672	2.075	49	.043
	Male	21	41.58	19.458			
Sleep Problems Index II	Female	30	55.63	16.474	2.316	49	.025
	Male	21	43.79	19.935			

Note: *p<.05

Results

The sample consisted of 51 patients (30 females and 21 males) seeking care at a chiropractic and rehabilitative clinic 6/29/2010 through 2/8/2011. All of these patients presented with an initial primary diagnosis of cervical segmental dysfunction and all but two subjects also presented to the clinic with a secondary related diagnosis, of which lumbar segmental dysfunction (59%, n=30) and thoracic segmental dysfunction (33%, n=17) were most frequently diagnosed. The sample had a mean age of 36.55 (+/-12.57), with the majority of the sample being female (58.8%, n=30). The average number of days since the onset of symptoms was 7.73 (6.75) days since the onset of symptoms. None of the sleep characteristics were correlated with number of visits to the clinic, days since onset of symptoms, neck disability or pain (Table 1). Table 2 indicates 95% confidence interval (CI) represented by the study sample and the mean value for these measures based upon the general non-WAD population.[21-23] When comparing the mean values from the general population it appears that the WAD population presents for treatment at the clinic with significantly greater measures of neck disability (NDI), neck pain (VAS), sleep disturbance, snoring, shortness of breath and headache, sleep somnolence and sleep problems index I and II (Table 2). The WAD population in this study also presents with significantly lower measures of optimal sleep when compared to the general population. However, the WAD population did not report different amounts of sleep adequacy than the general population. Finally, Table 3 indicates that the female WAD patients reported significantly higher sleep disturbance, sleep problems 1 and problems 2 than the male WAD patients.

Discussion

The findings indicate that WAD patients present with several differences in neck disability and pain, and sleep quantity and quality when compared to the general, non-WAD population. No characteristics of sleep represented by the MOS Sleep Scale were related to the number of visits to the clinic, days since onset of symptoms, neck disability, or neck pain. Interestingly, it does not appear that the patients' perceptions of disability or pain were related to their self-reported sleep characteristics. This may indicate that the WAD population in this study does not define their disability in terms of pain or poor sleep, but rather by another measure (such as ability to perform functional tasks) that was not examined in this study. The lack of a definitive symptom-associations experienced by WAD patients in this study population is consistent with the literature, which indicates that as a multifactorial condition, the course and prognosis of WAD are difficult to predict and treat.[24-25] Studies have indicated that improving sleep quality of WAD patients through supportive therapies, such as the use of cervical neck pillows, may contribute to alleviating WAD symptoms and improving overall prognosis of the condition.[10-13] However, there are limited findings on the direct impact of sleep quality on the prognosis of WAD due to the complexities in assessing the impact of individual WAD symptoms on the outcomes of the condition. Individuals have different experiences of WAD symptoms and outcomes, and consequently require a

multifactorial approach to rehabilitative therapy and recovery. Therefore, continued research is warranted to explore how this population defines and perceives their disability, in relation to other factors, including pain and sleep.

Despite the lack of correlation between disability, pain, and sleep measures, the WAD population in this study reported greater neck disability and pain, sleep disturbances, snoring, shortness of breath and headache, sleep somnolence, and sleep problems, and poorer optimal sleep when compared to the general population. These findings are consistent with previous studies examining the complex nature of WAD symptoms.[2,4,26-28] In a study comparing fifty WAD patients and fifty healthy, age- and sex-matched controls, Haggman-Henrikson, Grongvist, and Eriksson found that in comparison to the healthy controls, the majority of WAD patients reported frequent pain in the jaw-face, neck, shoulders, head, and back, along with symptoms such as such stress and sleep disturbances.[27] Similarly, Berglund et al. found a higher prevalence of symptoms such as headaches, thoracic and lower back pain, fatigue, ill health, and sleep disturbances among WAD patients when compared to the general population.[2]Although current study findings did not indicate strong correlations between sleep and other WAD symptoms, Schlesinger, Hering-Hanit, and Dagan, found a significant correlation between sleep disturbances, physical whiplash injury symptoms, and anxiety.[4] However, the relationship between sleep and WAD symptoms is poorly understood, warranting the need for further research. According to Radanov, Mannion and Ballinari "sleep disturbance is the result of pain, which is a consequence of the trauma, and this may explain the development of comparable symptoms in pain conditions of different origin."[28(p.656)] This statement is particularly significant to the findings of the current study and provides evidence for the need to further explore sleep disturbances among WAD patients to establish a stronger understanding of the course and prognosis of this condition.

There is a dearth of research on the progression of disability in patients with WAD, making it challenging for clinicians to develop appropriate rehabilitative interventions and programs to minimize symptoms such as disability, pain and poor sleep, and improve quality of life of WAD patients.[29] Despite extensive research on the pathophysiology of WAD, understanding of prognostic factors that contribute to the progression of WAD symptoms remains unclear.[24-25,30-31] Furthermore, the lack of studies examining sleep quality and other characteristics among WAD patients in relation to chiropractic health and management of chronic WAD symptoms warrants the need for further research.[2-4,26] Findings from this study contribute to this gap by providing an understanding of the prognostic factors of disability, pain, and sleep in a sample of WAD patients in comparison to the general population.

Limitations

The purpose of this study was to explore sleep habits and characteristics of patients with WAD presenting at an outpatient clinic. This description included comparing sleep habits of WAD patients with population values from non-WAD patients. This methodology is susceptible to a number of threats to internal and external validity. The limited sample accessed from a single clinic may not represent all WAD patients. Since data were collected only once there was no way to determine if sleep characteristics changed as a result of therapy or if improvements in pain and disability were related to changes in sleep characteristics resulting from therapy. Further, non-WAD patients were not measured in this study and employing estimates of population pain, disability and sleep parameters based upon past studies and this approach may not yield an accurate description of these parameters for various subgroups of non-WAD patients. These limitations may be addressed in future studies to further validate the sleep habits and characteristics of WAD patients. Although beyond the scope of this study

future studies may also wish to examine the impact of sleep characteristics on healing or rates of recovery among WAD patients.

Conclusion

Although findings from this study indicate that WAD patients have significantly greater problems with neck disability, pain and sleep compared to the general population, it is important to acknowledge that the WAD population is heterogenous, including patients with varying levels of disability, pain, beliefs, and social backgrounds.[32] Therefore, assessing patients' needs on an individual basis and tailoring rehabilitation programs according to individual needs is essential in creating a successful intervention aimed at determining prognosis of WAD and improving outcomes. Clinicians can utilize these findings to improve rehabilitative interventions for WAD patients that involve a thorough assessment of individual factors and characteristics.

Findings from this study indicate that WAD patients have poor sleep outcomes, indicating the need for clinicians to assess sleep characteristics and incorporate interventions aimed at alleviating these symptoms when planning rehabilitation. Evaluating current therapies and interventions based on these findings may help identify innovative, multifactorial methods to alleviate both sleep disturbances and pain among WAD patients.[27-28] In order to provide a better understanding of the relationship between sleep, WAD symptoms, prognosis, and outcomes, it is recommended that future studies focus on measuring sleep characteristics of WAD patients as an integral prognostic factor. Continued research in understanding sleep disturbances in relation to disabilities and pain among WAD patients enhances clinician knowledge and development of rehabilitative interventions aimed at alleviating symptoms and improving overall quality of life.

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References

1. Dehner C, Heym B, Maier D, Sander S, Arand M, Elbel M, Hartwig E, Kramer M. Postural control deficit in acute QTF grade II whiplash injuries. *Gait &Posture* 2008 Jul; 28(1):113-9.

2. Berglund A, Alfredsson L, Jensen I, Cassidy D, Nygren A. The association between exposure to a rear-end collision and future health complaints. *J Clin Epidemiol* 2001;54: 851–856

3. Valenza, M.C., Valenza, G., Gonzalez-Jimenez, E., De-la-Llave-Rincon, A.I., Arroyo-Morrales, M., Fernandez-de-las-Penas, C. Alteration in sleep quality in patients with mechanism insidious neck pain and whiplash-associated neck pain. *Amer J Phys Med Rehabil* 2012;91:1-8.

4. Schlesinger I., Hering-Hanit R., Dagan Y. Sleep disturbances after whiplash injury: Objective and subjective findings. *Headache* 2001;41:586-589.

5. Sayar, K., Arikan, M., Yontem, T. Sleep quality in chronic pain patients. *Canadian J Psychiatry* 2002;47:844-8.

6. Smith, M.T., Perlis, ML, Smith, MS et al. Sleep quality in pre-sleep arousal in chronic pain. *J Behav Med* 2000;23: 1-13.

7. Braddom RL. Management of cervical pain syndromes. In DeLisa JA, Gans BM, eds. *Rehabilitation Medicine*. 2nd ed. Philadelphia: Lippincott, 1993: 1036-1046.

8. Bernateck M, Karst M, Merkesdal S, Fischer MJ, Gutenbrunner C. Sustained effects of comprehensive inpatient rehabilitative treatment and sleeping neck support in patients with chronic cervicobrachialgia: a prospective and randomized clinical trial. *Internat J Rehabil Res* 2008;31(4):342-6.

9. Hendriks EJ, Scholten-Peeters GG, van der Windt DA, Neeleman-van der Steen CW, Oostendorp RA, Verhagen AP: Prognostic factors for poor recovery in acute whiplash patients. *Pain* 2005, 114(3):408-416.

10. Ambrogio N, Cuttiford J, Lineker S, Li L. A comparison of three types of neck support in fibromyalgia patients. *Arthritis Care Res* 1998;11:405-410.

11. Hagino C, Boscariol J, Dover L, Letendre R, Wicks M. Before/after study to determine the effectiveness of the align-right cylindrical cervical pillow in reducing chronic neck pain severity. *J Manipulative Physiol Ther* 1998;21;89-93.

12. Persson L. Neck pain and pillows- A blinded study of the effect of pillows on non-specific neck pain, headache and sleep. *Adv Physiother* 2006;8: 122-127.

13. Shields N, Capper J, Polak T, Taylor N. Are cervical pillows effective in reducing neck pain? *New Zealand J Physiother* 2006;34(1):3-9.

14. McCaffery M, Pasero C. Pain: *Clinical Manual*, 2nd ed. St. Louis , MO : Mosby, Inc.; 1999:63.

15. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. *J Manipulative Physiol Ther* 1991 Sep;14(7):409-15.

16. Allen RP, Kosinski M, Hill-Zabala CE, Calloway MO. Psychometric evaluation and tests of validity of the Medical Outcomes Study 12-item Sleep Scale (MOS sleep). *Sleep Med* 2009;10(5): 531-9.

17. Harati Y, Gooch C, Swenson M, et al. Double blind randomized trial of tramadol for the treatment of the pain of diabetic neuropathy. *Neurol* 1998;50:1842–6.

18. Payne R, Mathias SD, Pasta DJ, et al. Quality of life and cancer pain: satisfaction and side effects with transdermal fentanyl versus oral morphine. *J Clin Oncol* 1998;16:1588–93.

19. Hays RD, Stewart AL. Sleep measures. In: Stewart AL, Ware JE Jr, eds., *Measuring Functioning and Well-Being: the Medical Outcomes Study Approach*. Durham (NC): Duke University Press; 1992.

20. Rao V, Spiro J, Vaishnavi S, et al. Prevalence and types of sleep disturbances acutely after traumatic brain injury. *Brain Injury* 2008; 22:381-386.

21. Hays RD, Martin, SA, Sesti AM, Spritzer KL. Psychometric properties of the Medical Outcomes Study Sleep measure. *Sleep Med* 2005;6:41-44.

22. Kato S, Takeshita K, Matsudaira K, Tonosu J, Hara N, Chikuda H. Normative score and cut-off of the Neck Disability Index. *J Orthopaedic Science*, 2012.

23. Spritzer KL, Hays RD. *MOS Sleep Scale: A Manual for Use and Scoring, Version 1.0*. Los Angeles, CA; 2003.

24. Carroll LJ, Liu Y, Holm LW, Cassidy JK, Cote P. Pain-related emotions in early stages of recovery in whiplash-associated disorders: their presence, intensity, and association with pain recovery. *Psychosom Med* 2011;73:708-15.

25. Carroll LJ, Holm LW, Hogg-Johnson S, Cote P, Cassidy JD, Haldeman S et al. Course and prognostic factors for neck pain in whiplash-associated disorders (WAD): Results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *J Manipulative Physiol Ther* 2009;32(2Suppl):S97-107.

26. Radanov BP, Mannion AF, Ballinari P. Are symptoms of late whiplash specific? A comparison of SCL-90-R symptom profiles of patients with late whiplash and patients with chronic pain due to other types of trauma. *J Rheumatol* 2011;38;1086-94.

27. Haggman-Henrikson B, Grongvist J, Eriksson PO. Frequent jaw-face pain in chronic whiplash associated disorders. *Swed Dent J* 2011;35(3):123-31

28. Radanov BP, Mannion AF, Ballinari P. Dr. Radanov, et al reply. *J Rheumatol* 2012;39:656-657.

29. Shmitt MA, van Meeteren NLU, de Wijer A, Helders PJM, van der Graaf Y. *BMC Musculoskel Disorders* 2008;9:168-173.

30. Kamper SJ, Rebbeck, TJ, Maher, CG, McAuley JH, Sterling M. Course and prognostic factors of whiplash: A systematic review and meta-analysis. *Pain* 2008;138:617-629.

31. Cote P, Cassidy D, Carroll L, Frank JW, Bombardier C. A systematic review of the prognosis of acute whiplash and new conceptual framework to synthesize the literature. *Spine* 2001;26:E445-E58.

32. Sterling M, Jull G, Vicenzino B, Kenardy J, Carnell R. Physical and psychological factors predict outcome following whiplash injury. *Pain* 2005;114(1-2):141-148.