

# An Analysis of Various Factors Affecting Neck Pain and Dysfunction in Adults with Chronic Neck Pain Using Regression Analysis

**Background:** The prevalence of neck pain and neck dysfunction is high in general population. However, there is little literature on the relationship and factors affecting neck pain and neck dysfunction.

**Objective:** To investigate the correlation between neck and shoulder pain, headaches, neck and shoulder dysfunction, and sleep quality in adults with chronic neck pain, and factors affecting neck pain and neck dysfunction.

**Design:** Cross-sectional study

**Methods :** The sample included 114 subjects, who had complained of chronic neck pain for more 12 weeks. We conducted a Pearson's correlation between neck and shoulder pain, headaches, neck and shoulder dysfunction and sleep quality and a regression analysis of the related variables, thereby analyzing factors affecting neck pain and neck dysfunction.

**Results :** In the present study, in adults with chronic neck pain, neck pain was positively correlated with the Neck Disability Index (NDI), Shoulder Pain and Disability Index (SPADI)-Pain score, and SPADI-Total score ( $p < .05$ ). The NDI was positively correlated with neck pain, SPADI-Pain score, and SPADI-Total score, as well as with Pittsburgh Sleep Quality Index(PSQI-K) ( $p < .05$ ). Among the factors affecting neck pain, shoulder disability as assessed by the SPADI was a significantly associated with neck pain, while shoulder pain and shoulder disability determined by the SPADI were identified as significant variables among the factors affecting neck disability.

**Conclusion :** These results indicated that as neck pain worsened, shoulder pain and neck and shoulder dysfunction also increased, which suggested that shoulder disability affected neck pain. In addition, as the neck dysfunction increased, neck pain and shoulder pain and shoulder dysfunction increased, and sleep quality deteriorated, which suggested that shoulder pain and shoulder disability affected neck disability.

**Key words:** *Chronic neck pain; Neck disability Index; Shoulder pain; Shoulder disability*

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## INTRODUCTION

Neck pain refers to cervical vertebra joint disorders accompanied by pain in the upper spinal regions, including the neck, back of the head, and shoulders, in addition to limitations in joint movement. Neck pain may be caused by physical stress associated with anatomical abnormalities, bad posture, or muscle tension and fatigue due to repeated movements. Neurological and psychological factors, in addition to

systemic metabolic factors (e.g., endocrine system abnormalities or malnutrition), may also be related to neck pain, all of which can lead to problems in daily activities of living.<sup>1</sup> An additional cause of neck pain today is smartphone, tablet, and personal computer usage, with excessive usage linked to musculoskeletal system disorders, which are accompanied by neck and shoulder muscle pain and discomfort.<sup>2</sup>

Musculoskeletal disorders are extremely common, with approximately 80% of individuals experiencing

musculoskeletal-related problems at least once during their lifetime. These disorders are frequently accompanied by neck disability, regardless of age or sex. In many cases, such disorders progress to chronic pain.<sup>3</sup> In addition, chronic bad posture and chronic neck and head muscle fatigue can cause muscle tension, which may lead to tension-type headaches.<sup>4</sup> Headaches and sleep are similar in that both are greatly influenced by psychological conditions and the surrounding environment. A severe headache can interfere with sleep, and a sleep disorder can cause sensory changes for pain.<sup>5</sup>

Pain related to the cervical vertebrae may be accompanied by dysfunction of the upper extremities.<sup>6</sup> Such pain is caused by dysfunction of joints, muscles, ligaments, and other soft tissues of the neck. Previous research reported that neck pain was related to joint dysfunction of the cervical vertebrae and the structures surrounding them.<sup>7</sup>

The purpose of this study was to investigate the relationships among pain, headaches, neck and shoulder dysfunction, and sleep quality in adults with chronic neck pain and to predict factors affecting neck pain and neck disability, thereby providing basic data for the treatment of adult patients with chronic neck pain.

## SUBJECTS AND METHODS

### Subjects

In total, 114 college adults (55 males and 59 females) in their 20s who were attending N University located in Chungcheongnam-do were included in this study. The study was conducted between 1 May 2019 and 31 August 2019. Pain that lasted for more than 12 weeks was classified as chronic.<sup>8</sup> Only patients with chronic pain for more than 12 weeks since the onset of neck pain were included in this study.

Exclusion criteria were: musculoskeletal and neurological surgical experiences that could have affected the study, neck trauma (defined as a history of trauma

to the neck, fracture, distortion and violent attack which have caused the current neck pain), whiplash injury, severe disorder of the cervical spine (disk prolapse, spinal stenosis, fibromyalgia), severe physical and/or mental diseases, medication overuse headache.<sup>9,10</sup>

Before the study began, the objectives of this study were fully explained to the subjects. All the subjects provided written informed consent. Prior to the study commencing, the recruitment of the subjects and relevant procedures were reviewed and approved by the Institutional Review Board of Yongin University (Approval number: 2-1040966-AB-N-01-20-1812-HSR-126-10). The general characteristics of the subjects are shown in Table 1.

### Measurements Method

#### Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) is the most used method for assessing pain intensity. To evaluate the degree of pain using the VAS, the subjects were instructed to mark the degree of pain that they currently experienced on the scaled line. The scales ranged from 0 (painless) to 10 (extreme pain).<sup>11</sup> The test-retest reliability was very high, with an inter-class correlation coefficient (ICC) of .97.<sup>12</sup>

#### Headache Impact Test-6 (HIT-6)

The HIT is a questionnaire based on the Internet HIT and consists of six questions relating to pain, social function, role function, cognitive function, psychological pain, and vitality. The answers are scored using a 5-point Likert scale (1=never, 5=always). The higher the total score, the more severe the impact of the headache, with 36-49 points indicating no or little impact, 50-55 points indicating some impact, 56-59 points indicating a significant impact, and 60 or higher points indicating a severe impact. The Korean version of the HIT-6 was used, and its reliability was .76 to .83.<sup>13</sup> The headache patterns of the subjects included unilateral or bilateral pain in the head, occipital, or retro-orbital areas and

**Table 1.** General characteristics of the subjects (N = 114).

	Male(n = 55)	Female(n = 59)	Total(n = 114)
Age (y)	25.31 ± 4.31	22.21 ± 3.34	23.70 ± 4.12
Height (cm)	173.21 ± 5.65	160.20 ± 5.20	166.48 ± 8.47
Weight (kg)	76.13 ± 14.41	57.12 ± 9.66	66.29 ± 15.43
BMI (%)	25.31 ± 4.31	22.21 ± 3.34	23.70 ± 4.13

BMI, body mass index

pain in the form of pressure or tightening, with mild to moderate pain intensity.

### Neck and shoulder dysfunction

#### 1) Neck Disability Index (NDI)

The NDI is a self-report questionnaire, which consists of 10 questions, including seven questions related to functional activity status, two questions relating to symptoms, and one question relating to concentration. The NDI score is the sum of each item, and the higher the score, the greater the dysfunction related to abnormalities in the neck area. According to the NDI, scores of 0-4 denote no disability, and scores of 5-14, 15-24, and 25-34 signify mild, moderate, and severe disability, respectively. A score of 35 or higher denotes complete disability. Among neck pain evaluation methods, the NDI is the most popular method used for clinical evaluations and research experiments, and it is considered a reliable and useful assessment tool for neck pain.<sup>14</sup>

#### 2) Shoulder Pain and Disability Index (SPADI)

This index consists of 13 evaluation items designed to measure the degree of movement disability, as well as various activities of daily living of the upper limb. Five questions on the SPADI are related to the degree of pain, and eight questions are related to function/disability, where 0 points indicate "no pain" and "easy" and 10 points indicate "severe pain" and "cannot be performed unaided." The scores on these subscales are calculated to give an overall pain score, overall disability score, and total score.<sup>15</sup> As shown in previous research, the Korean version of the SPADI was very reliable, with an interclass correlation coefficient of .991.<sup>16</sup>

### Pittsburgh Sleep Quality Index (PSQI-K)

The quality of sleep was evaluated using the PSQI-K (Korean version of the PSQI), which was translated from the Pittsburgh Sleep Quality Index (PSQI)

developed by Buysse et al.<sup>17</sup> and then tested for its reliability and validity by Sohn et al.<sup>18</sup> The index consists of 19 questions on seven areas relating to sleeping habits, including subjective sleep quality, sleep latency, sleep duration, habitual sleep effects, sleep disturbances, sleep medication use, and daytime dysfunction, over the past month. The overall sleep quality was calculated by scoring each area according to the sleep quality index evaluation method and then adding up the scores of each area. Higher total scores denoted lower sleep quality. Cronbach's  $\alpha$  for the reliability of this tool was .83 at the time of its development, and that of the Korean version was .84 in Sohn's study.<sup>19</sup>

### Data analysis

The data collected in this study was analyzed using SPSS WIN (ver. 20.0). Descriptive statistics were used to identify the general characteristics of the subjects. The data are summarized using the mean and standard deviation. Pearson's correlation was used to examine the correlations between neck and shoulder pain, headaches, neck and shoulder dysfunction and sleep quality, and a multiple regression analysis was performed to investigate factors that affected neck pain and neck dysfunction. In all the analyses, was an  $\alpha$  value of .05.

## RESULTS

### Correlations between neck and shoulder pain, headaches, neck and shoulder dysfunction, and sleep quality

The scores of the variables and the correlations between them are shown in Tables 2 and 3. Neck pain was positively correlated with the NDI, SPADI-

**Table 2.** Pain, headache, neck and shoulder dysfunction, and sleep quality levels

Variables		Mean $\pm$ Standard deviation
VAS	Neck	3.29 $\pm$ 1.60
Headaches		42.04 $\pm$ 7.66
NDI		3.12 $\pm$ 2.08
SPADI	Pain	7.47 $\pm$ 9.08
	Disability	1.13 $\pm$ 1.77
	Total	4.55 $\pm$ 4.97
PSQI-K		4.17 $\pm$ 2.50

VAS, Visual Analogue Scale; NDI, Neck Disability Index; SPADI, Shoulder Pain and Disability Index; PSQI-K, Pittsburgh Sleep Quality Index

Pain score, and SPADI–Total score ( $p < .05$ ). The NDI was positively correlated with neck pain, haedaches, SPADI–Pain score, SPADI–Total score, and sleep quality index ( $p < .05$ ).

**Factors affecting neck pain and neck dysfunction**

The multiple regression analysis performed using neck pain as a dependent variable revealed that the R–squared value was .308 and that the adjusted R–squared value was .282, as shown in Table 4. Among

the factors affecting neck pain, SPADI–Disability was a significant variable, but no collinearity was found among the variables.

The multiple regression analysis performed using NDI as a dependent variable revealed an R–squared value of .226 and an adjusted R–squared value of .205, as shown in Table 5. Among the factors affecting neck dysfunction levels, SPADI–Pain and SPADI–Disability were identified as significant variables, but no collinearity was found among the variables.

**Table 3.** Correlations between pain, headaches, neck and shoulder dysfunction, and sleep quality

Variables		Pearson’s correlation coefficients	p
VAS (Neck)	NDI	.256	.006*
	SPADI (Pain)	.216	.021*
	SPADI (Total)	.224	.016*
NDI	VAS (Neck)	.256	.006*
	Headache	.348	.000*
	SPADI (Pain)	.381	.000*
	SPADI (Total)	.348	.000*
	PSQI–K	.256	.006*

VAS, Visual Analogue Scale; NDI, Neck Disability Index; PSQI–K, Pittsburgh Sleep Quality Index; SPADI, Shoulder Pain and Disability Index; \* $p < .05$ .

**Table 4.** Regression analysis of factors affecting neck pain

Variables	Non standardized coefficients		Standardized coefficients	t	p	VIF
	B	Standard error	Beta			
SPADI (Disability)	.109	.017	.530	6.532	.000	1.019

SPADI, Shoulder Pain and Disability Index; VIF, Variance Inflation Factor; \* $p < .05$

**Table 5.** Regression analysis of factors affection neck dysfunction

Variables	Non standardized coefficients		Standardized coefficients	t	p	VIF
	B	Standard error	Beta			
SPADI (Pain)	.076	.021	.332	3.648	.000	1.178
SPADI (Disability)	.078	.023	.289	3.368	.001	1.046

SPADI, Shoulder Pain and Disability Index; VIF, Variance Inflation Factor; \* $p < .05$ .

## DISCUSSION

This study aimed to investigate the relationships between neck and shoulder pain, headaches, neck and shoulder dysfunction, and sleep quality in adults with chronic pain and to identify factors affecting neck pain and neck dysfunction levels. Neck pain was positively correlated with the NDI, SPADI–Pain score, and SPADI–Total score. In addition, SPADI–Disability affected factor to neck pain. This results showed that as neck pain worsened, shoulder pain increased, and neck and shoulder dysfunction also increased. That is, as the neck pain increased not only increase neck disability but also shoulder pain when activities (e.g. reaching for something on a high shelf, pushing with the involved arm). This is thought that as the neck pain increased increase the dysfunction and as the limitation of daily life increased increases the neck pain.

A study reported that on the correlation between the neck pain and disability, and shoulder pain and disability in 43 patients with chronic neck pain. The results of this study revealed VAS–neck score showed good correlation with score of NDI, SPADI–Pain score, SPADI–Total score.<sup>20</sup> Hermann and Reese reported that the relationships among commonly assessed impairment, functional limitation, and disability measures in patients with cervical spine disorder. This result of this study revealed positive correlation between the neck pain, and the NDI for the disability measures.<sup>21</sup>

In the present study, the NDI was positively correlated with neck pain, headaches, SPADI–Pain score, SPADI–Total score, and sleep quality index. In addition, SPADI–Pain and SPADI–Disability were identified as factors that affected the NDI. These findings can be interpreted as follows: the higher the neck dysfunction, the severer the neck pain, headache, and shoulder pain, and the lower the sleep quality. It is thought that as the limit on activity daily life increased due to neck pain, the shoulder pain and the limitation on functional movement of the shoulder also increased, affecting the neck dysfunction.

These results are consistent with studies analyzed the relationship between pain and disability levels in 24 adults suffering from neck and shoulder pain. The results of their study showed that intensity of neck pain and level of disability were positively correlated and that the NDI and SPADI (total and disability) were moderately correlated.<sup>22</sup> A study reported that patients with mechanical neck pain exhibited a greater neck disability and worse sleep quality than controls. The Pittsburgh Sleep Quality Index score

was associated with intensity of neck pain and neck disability.<sup>23</sup> A study reported that people with primary headaches (migraines and/or tension headaches) were more likely than those without headaches to have neck pain and that neck pain was most commonly observed in those with both migraines and tension–type headaches.<sup>24</sup> Others showed that chronic tension–type headaches caused not only pain but also other disabilities, such as a decreased range of neck movement and sleep disorders.<sup>25</sup> The same study showed that they led to reduced work performance and increased stress among office workers.

Therefore in the present study, as neck and shoulder pain increases, the level of disability and discomfort in everyday life increases. In addition, neck pain and neck disability are related to shoulder pain and shoulder disability, which suggests that the severer the pain and disability of the shoulder, the severer the pain and disability of the neck.

It could be interpreted that adults with chronic neck pain had shoulder pain and shoulder dysfunction as well as neck disability compared to those without neck pain. Therefore, it is very important to improve the function of the neck and shoulder in treatment of chronic neck pain. In the present study did report causal relationship as well as the correlation of the variables associated with neck pain, which is great clinical significance.

Limitations of the study were that subjects were recruited from 20s adults in N–University and may, therefore, not represent the total chronic neck pain population. In addition, the results of the present study could have affected due to a small number of samples and mild intensity of both pain and dysfunction. In the future, a larger sample of participants would allow for separate by ages analyses of those with neck pain and neck dysfunction by ages.

## CONCLUSION

The present study analyzed the relationship of neck and shoulder pain, headaches, neck and shoulder dysfunction and sleep quality in 114 adults with chronic neck pain. The results showed that neck pain was positively correlated with the NDI, SPADI–Pain score, and SPADI–Total score. Furthermore, the SPADI–Disability score was identified as a factor affecting neck pain. The NDI exhibited a significant positive correlation with neck pain, headaches, SPADI–Pain score, SPADI–Total score, and sleep quality index, and the SPADI–Pain score and SPADI–

Disability score were identified as factors affecting the NDI. These findings suggested that as the severity of neck pain and dysfunction increased so too did the severity of shoulder pain and dysfunction, thereby increasing the level of disability and discomfort in daily activities of living. Among other factors, the levels of shoulder pain and disability can be considered as factors affecting pain and dysfunction of the neck. Therefore, appropriate programs that can improve not only neck pain but also shoulder pain and function should be incorporated into physical therapy programs for adults with chronic neck pain. The results of this study can provide basic data for the treatment of adult patients with chronic neck pain. Further studies, can be used to identify the clinical course of neck pain and dysfunction, and assist in prevention programs. The further study can be used to investigate whether treatments for shoulder pain and dysfunction will affect improvement of neck pain and dysfunction.

## REFERENCES

1. Jun IS. The effects of craniocervical flexion exercise accompanied by mandibular opening on the thickness of deep cervical flexors and static stability in neck pain patients. [Doctoral thesis]. Gyeongsan, KR: Daegu University; 2014.
2. Ko MK, Song CH, Yu JH. The effects of long-term smartphone usage time and of stretching on stiffness, concentration and visual acuity. *PNF & Mov.* 2019;17(1):57–68.
3. Seo DY. The effect of joint mobilization to upper thoracic vertebrae in craniocervical angle and autonomic function and serotonin in chronic cervical pain. [Doctoral thesis]. Naju, KR: Dongshin University; 2016.
4. Koo SJ, Choe JG. Evaluation of craniocervical posture in the patients with chronic tensional headache. *J Oral Med Pain.* 1993;18(1):9–14.
5. Shin HK, Eun BL, Nam SO, et al. Sleep problems in children and adolescents with epilepsy and chronic headaches. *J Korean Child Neurol Soc.* 2010;18(1):66–73.
6. Lee HS, Yoo JH. The effects of stretching and isometric exercise for chronic neck pain patient in strength and pain. *J Korean Soc Phys Med.* 2012;7(3):329–37.
7. Schoeneck SK, Jensen G, Nicholson G, et al. The effect of mobilization on cervical headaches. *J Orthop Sports Phys Ther.* 1995;21(4):184–96.
8. Choi IS, Jang HJ, Kim SY. Regression analysis of the relationship among the level of pain and dysfunction and psychosocial factors in patients with chronic back pain. *Phys Ther Korea.* 2016;23(1):38–45.
9. Park SY. Regression analysis on the cause of neck pain and the effect of orthopedic manipulative physical therapy for neck pain associated headache reduction. [Doctoral thesis]. Yongin, KR: Yongin University. 2018.
10. Krøll LS, Hammarlund CS, Westergaard ML et al. Level of physical activity, well-being, stress and self-rated health in persons with migraine and co-existing tension-type headache and neck pain. *J Headache Pain.* 2017;18(1):46.
11. Lee GC, Lee DY. The effects of deep neck flexor exercise on pain and neck disability index of the patients with chronic neck pain. *JKAIS.* 2010;11(11):4331–37.
12. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. *Acad Emerg Med.* 2001;8(12):1153–7.
13. Chu MK, Im HJ, Ju YS et al. Validity and reliability assessment of korean headache impact test-6 (HIT-6). *J Korean Neurol Assoc.* 2009;27(1):1–6.
14. Do JH. Effects of a physical therapy program on quality of life, and neck and shoulder disability in patients with head and neck cancer. *Phys Ther Kor.* 2013;20(1):36–46.
15. Park SJ, Kim SY. The effect of scapular dynamic taping on pain, disability, upper body posture and range of motion in the postoperative shoulder. *J Korean Soc Phys Med.* 2018;13(4):149–62.
16. Seo HD, Lee KW, Jung KS, et al. Reliability and validity of the korean version of shoulder pain and disability index. *ISERS.* 2012;5(2):319–36.
17. Buysse DJ, Reynolds CF, Monk TH, et al. The pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28(2):193–213.
18. Sohn SI, Kim DH, Lee MY, et al. The reliability and validity of the Korean version of the pittsburgh sleep quality index. *Sleep Breath.* 2012;16(3):803–12.
19. An MJ, Kim JS, Heo SK, et al. Factors affecting sleep quality of clinical nurses working in a hospital. *Korean J Adult Nurs.* 2018;30(2):126–35.
20. Hwang SJ, Mun MH. Relationship of neck disability index, shoulder pain and disability index, and visual analogue scale in individuals with chronic neck pain. *Phys Ther Rehabil Sci.* 2013;2(2):111–4.

21. Hermann KM, Reese CS. Relationships among selected measures of impairment, functional limitation, and disability in patients with cervical spine disorders. *Phys Ther.* 2001;81(3):903–14.
22. Jeon HC, Yang KW, Kim KH, et al. Relationship of pain, disability and quality of life in individual with neck and shoulder pain. *J Kor Phys Ther.* 2016;28(5):328–33.
23. Sonsoles MM, Maria MG, Francisco AS, et al. Myofascial trigger points, pain, disability, and sleep quality in individuals with mechanical neck pain. *J Manipulative Physiol Ther.* 2012;35(8):608–13.
24. Ashina S, Bendtsen L, Lyngberg AC, et al. Prevalence of neck pain in migraine and tension-type headache: A population study. *Cephalalgia.* 2015;35(3):211–9.
25. Lee HR, Shim JH, Oh DW. Effects of high-frequency diathermy integrated into suboccipital release on tenderness and neck mobility and disability in people with chronic tension-type headache. *Phys Ther Korea.* 2017;24(2):37–47.