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Research Article

The Effects of Chronic Neck Pain on Spinal Posture, Spinal Mobility and Handgrip Strength in Older Adults

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Abstract

Aim: The objective of the study was to compare spinal posture, spinal mobility, and handgrip strength between the participants aged 65 and over with and without Chronic Neck Pain (CNP).
Material and Method: A total of 35 participants aged 65 and over, 17 older people with a diagnosis of CNP (CNP group) and 18 older people without CNP (control group), were included in this cross-sectional study. The Spinal Mouse device was used to measure spinal posture for the positions of vertebral column and spinal mobility for the movements in sagittal and frontal planes for the vertebral column. Handgrip strength was measured with a hand dynamometer.
Results: The mean age of the CNP group and the control group were 69.88±4.66 years and 71.50±4.61 years (p>0.05), respectively. There were significant differences in right and left handgrip strength between the CNP group and the control group, respectively (p=0.008, p=0.022). According to the spinal posture values, the mean length of the vertebral column in CNP group was higher than the controls (p=0.028). In addition, the lumbar and pelvic inclination angles were different between the groups in maximum flexion positions (p=0.040 and p=0.027, respectively). According to the spinal mobility values, the mean pelvic inclination angle was lower in the CNP group than the controls from the upright position to the flexion movement (p=0.023). In addition, the lumbar and pelvic inclination angles were lower in the CNP group than the controls from the maximum extension to the maximum flexion movement (p=0.017 and p=0.013, respectively).
Conclusion: This study showed that the length of the vertebral column and the grip strength were higher in the older adults with CNP than the controls. According to the spinal posture, the lumbar angle and pelvic inclination angle were lower in the older adults with CNP than the controls. According to the spinal mobility, the pelvic inclination and lumbar angles in the older adults with CNP were lower than the controls.

Keywords: Chronic neck pain, handgrip strength, spinal posture, spinal mobility, spinal curvature

INTRODUCTION

Neck pain is characterized as discomfort in the cervical region persisting for at least one day, potentially accompanied by reflective pain in one or both upper limbs. Typically, the prognosis for neck pain indicates a favorable trend towards improvement during the initial six weeks following onset. There is a tendency for certain individuals who suffer from neck pain to develop chronic or persistent symptoms. Like other musculoskeletal disorders, neck pain is categorized based on the duration of the symptoms as acute (up to 6 weeks), subacute (6 to 12 weeks), and chronic (>12 weeks) (1).

Chronic neck pain (CNP) is a common problem in society arising from various etiological factors. Stress, insufficient sleep, poor posture and sitting positions, excess weight, and trauma are all risk factors for persistent neck pain (2). CNP ranks fourth globally in terms of causing disability and accounts for 10–20% of primary care visits. Due to degenerative changes in the joints and intervertebral disc collapse, it is more prevalent in older people (3).

Considering that the population aged 65 and over in Türkiye is 8,722,806, there are more than 200,000 people with CNP in this age group in our country (4,5). The considerable economic strain associated with CNP arises from the expenses of treatment, reduced productivity, and a decrease in the labor force (6). In particular, resistance exercises and posture training positively affect CNP (7-10).

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In literature, it was shown that hand grip strength is influenced by multiple factors such as age, gender, body mass index, leisure activities, occupation, upper extremity muscular strength, pain, nutritional status, sensory impairment, and cognitive decline. Additionally, several conditions, including carpal tunnel syndrome and cervical radiculopathy, were linked to a reduction in hand grip strength. Hand grip strength is also adversely affected by neck pain (11).

Alterations in postural control among individuals with Chronic Neck Pain (CNP) vary according to the underlying cause of their condition. Within diverse neck pain syndromes, specific and characteristic deficits in posture regulation can be observed and assessed. It is hypothesized that differences in postural stability and performance arise from varying degrees of disruption either in the afferent proprioceptive information transmitted to the central nervous system or in the subsequent central processing and integration of these sensory inputs (12).

From a functional perspective, CNP is a common musculoskeletal issue that can adversely impact hand grip strength, spinal posture, spinal mobility, and spinal curvature. This study aimed to compare the hand grip strength, spinal posture, spinal mobility, and spinal curvature between individuals aged 65 or over with and without CNP.

MATERIAL AND METHOD

Patients with CNP (patient group) who applied to the Physiotherapy and Rehabilitation Unit, Izmir Aliaga State Hospital, and individuals without CNP (control group) who met the inclusion criteria were included in this cross-sectional study. Ethical approval was obtained from İzmir Bakırçay University Ethics Committee for the study (2022/642, date: 22.06.2022).

The inclusion criteria were (1) being 65 years and over, (2) being diagnosed with CNP, (3) having CNP at least 12 weeks for the patient group; (1) being 65 years and over, (2) having no previous history of neck pain for the control group. The exclusion criteria were (1) having reading-comprehension problems, (2) having any orthopedic or neurological diseases or cognitive disorders, (3) having any head and cervical spine injury or surgery, and (4) having a score below 24 according to Mini-Mental State Examination (MMSE) for both the patient and the control groups.

Outcome Measures

Demographic information of the participants including age, gender, height, and body weight was recorded. All evaluations were applied to all the participants once by the same researcher.

The severity of the neck pain in patients diagnosed with CNP was evaluated using the Visual Analogue Scale (VAS). The VAS has a horizontal line that is 100 mm length. At each end of the line are word descriptors representing symptom severity from 0 (no symptoms/pain) to 10 (very severe symptoms/pain). The patient marked the point on the line that they believe reflects their perception of the current situation. The VAS score was calculated by measuring the distance from the beginning point on the left side of the line to the point marked by the patient (13).

The Spinal Mouse® (Idiag M360, Volkerswill, Switzerland), a non-invasive and computer-assisted device, was used to evaluate spinal posture and spinal mobility. Before the measurement, the spinal processes of the spine from C7 to S3 were marked while the individual was standing. During the evaluation, measurements were obtained by moving the Spinal Mouse device from top to bottom along the spine. During recording, the device recorded the distances and positions of the vertebrae in the x, y, and z planes. The intra-rater reliability (>0.8) and inter-rater reliability (0.95) of the Spinal Mouse device were documented previously (14,15). Spinal posture in the sagittal plane was evaluated in the upright posture, maximum flexion, and maximum extension positions, while in the frontal plane, it was assessed in upright posture, maximum left lateral flexion, and maximum right lateral flexion positions. The movements between the related positions evaluated spinal mobility in sagittal and frontal planes. Thoracic angle (°), lumbar angle (°), sacral angle (°), pelvic inclination angle (°), and length (mm) of the vertebral column data were calculated using a software program (IDIAG M360pro 7.7.0, Switzerland) to determine the spinal posture and spinal mobility of the participants in each position and movement. Positive values represent anterior posture (kyphosis) or flexion movement for the sagittal plane and right-side posture for the frontal plane, whereas negative values represent posterior posture (kyphosis) or extension movement for the sagittal plane and left-side posture for the frontal plane.

The upper extremity grip strength of the participants was evaluated using a handheld dynamometer (Lafayette Professional Hand Dynamometer, 5030L1, USA). Participants were assessed for right- and left-hand grip strength in a sitting position, with the arm fully adduction position and the elbow at 90 degrees flexion position. The best value obtained from three consecutive measurements was recorded (16,17).

Statistical Analysis

The G*Power program was used to determine the number of participants enrolled in the study. Cohen's d effect size was 1.02 in a study comparing thoracic kyphosis angle for spinal posture in sagittal plane upright position in older adults (18). Accordingly, we calculated the sample size to complete the study with a minimum of 34 participants in total, ensuring at least 17 participants in each group with 80% power, $\alpha=0.05$ error probability, and Cohen's d effect size of at least "1.02".

Data analysis was conducted with the IBM SPSS 20.0 statistical software program. Data were expressed as mean and standard deviation. The Shapiro-Wilk test was used to perform normal distribution analysis for continuous variables, and it was determined that all data showed normal distribution. Therefore, the Student's t-test was used for statistical analysis in independent two-group comparisons. $p<0.05$ probability value was considered statistically significant.

RESULTS

A total of 35 older adults participated in this study. Seventeen older adults were diagnosed with CNP, whereas 18 did not have such a diagnosis. The mean VAS score of the older adults diagnosed with CNP was 6.82±1.54 cm.

There was no statistically significant difference among the participants regarding age, height, weight, and BMI (Table 1). Regarding age, height, weight, and BMI, the subjects did not show any statistically noteworthy variation (Table 1). While the mean left-hand grip strength was 26.88±7.07 kg and 33.78±9.58 kg, respectively (p=0.222), the mean right-hand grip strength was 27.53±8.49 kg and 36.11±9.6 in the CNP group and the control group, respectively (p=0.008).

Table 1. Demographic information

	CNP group (n=17) (mean±SD)	Control group (n=18) (mean±SD)	p
Age (year)	69.88±4.66	71.50±4.61	0.31
Heigh (m)	1.64±0.95	1.61±0.96	0.51
Weight (kg)	79.29±11.20	75.06±9.32	0.23
BMI (kg/m²)	29.59±4.67	28.76±3.99	0.57

CNP: chronic neck pain, BMI: body mass index

According to the spinal posture values in the sagittal plane, the mean length of the vertebral column was higher in the CNP group than the control group in the upright position (p=0.028). The lumbar and pelvic inclination angles were lower in the CNP group than the control group in maximum flexion positions (p=0.040 and p=0.027, respectively). In addition, the absolute value of the pelvic inclination angle was lower in the CNP group than the control group in the maximum flexion position (p=0.030) (Table 2).

Table 2. Comparison of the spinal posture and spinal mobility results

Spinal posture	Position	Data	CNP Group (n=17) (mean±SD)	Control Group (n=18) (mean±SD)	p
Sagittal	Upright	Thoracic (°)	58.29±14.13	54.50±12.44	0.405
		Lumbar (°)	-26.00±18.79	-20.11±16.98	0.337
		Sacral (°)	13.65±12.495	7.89±12.75	0.187
		Pelvic inclination (°)	6.35±6.480	3.67±4.86	0.173
		Length (mm)	506.53±40.84	446.89±99.64	0.028*
	Maximum flexion	Thoracic (°)	54.47±13.00	53.72±9.90	0.849
		Lumbar (°)	2.53±17.99	12.94±9.88	0.040*
		Sacral (°)	61.71±12.854	62.61±20.96	0.879
		Pelvic inclination (°)	75.94±12.11	86.83±15.50	0.027*
		Length (mm)	520.06±51.878	494.11±44.22	0.120
	Maximum extension	Thoracic (°)	41.47±15.005	39.22±19.29	0.704
		Lumbar (°)	-20.12±23.593	-27.06±23.02	0.385
		Sacral (°)	4.53±11.609	-.17±15.73	0.325
		Pelvic inclination (°)	-7.12±9.51	-15.06±11.05	0.030*
		Length (mm)	475.65±35.976	450.00±42.49	0.063
Frontal	Upright	Thoracic (°)	0.76±3.66	4.17±5.51	0.040*
		Lumbar (°)	-0.47±4.57	-1.44±4.89	0.547
		Sacral (°)	.76±3.527	0.22±3.36	0.643
		Inclination (°)	0.47±1.06	0.22±1.92	0.643
		Length (mm)	504.24±48.37	466.94±35.64	0.014*
	Maximum left lateral flexion	Thoracic (°)	-12.18±7.88	-8.89±5.54	0.161
		Lumbar (°)	-7.53±5.52	-7.33±7.65	0.932
		Sacral (°)	-7.06±5.66	-11.61±7.55	0.053
		Pelvic inclination (°)	-16.18±6.51	-19.89±6.03	0.089
		Length (mm)	507.47±41.93	476.50±37.28	0.027*
	Maximum right lateral flexion	Thoracic (°)	14.94±8.69	22.72±6.94	0.006*
		Lumbar (°)	9.53±8.92	11.50±8.50	0.508
		Sacral (°)	3.06±5.65	3.67±5.36	0.746
		Pelvic inclination (°)	13.71±7.50	18.17±6.68	0.072
		Length (mm)	510.47±45.14	484.89±35.25	0.070*

CNP: chronic neck pain, *p<0.05

Table 2. Comparison of the spinal posture and spinal mobility results					
Spinal mobility	**Movement**	**Data**	**CNP Group (n=17) (mean±SD)**	**Control Group (n=18) (mean±SD)**	**p**
Sagittal	From upright position to maximum flexion	Thoracic (°)	-3.82±7.07	-0.78±10.04	0.310
		Lumbar (°)	26.53±19.21	34.17±12.00	0.165
		Sacral (°)	48.06±14.70	54.72±17.36	0.230
		Pelvic inclination (°)	69.59±15.88	83.17±17.57	0.023*
		Length (mm)	13.53±31.58	25.00±32.81	0.300
	From upright position to maximum extension	Thoracic (°)	-16.82±14.00	-12.50±18.21	0.439
		Lumbar (°)	0.12±20.70	-5.33±18.57	0.418
		Sacral (°)	-9.12±14.60	-5.83±14.77	0.513
		Pelvic inclination (°)	-13.47±7.23	-13.44±25.28	0.997
		Length (mm)	-30.88±24.47	-14.00±33.24	0.098
	From maximum extension to maximum flexion	Thoracic (°)	13.00±13.43	14.50±14.32	0.752
		Lumbar (°)	26.41±21.13	42.67±16.94	0.017*
		Sacral (°)	57.18±15.641	62.78±20.24	0.368
		Pelvic inclination (°)	83.06±19.84	101.89±22.41	0.013*
		Length (mm)	44.41±30.782	44.11±33.22	0.978
Frontal	From upright to maximum left lateral flexion	Thoracic (°)	-12.94±6.90	-13.06±8.21	0.965
		Lumbar (°)	-7.06±7.07	-5.89±7.43	0.637
		Sacral (°)	-7.82±6.16	-11.83±7.32	0.090
		Pelvic inclination (°)	-16.65±6.44	-20.11±5.28	0.090
		Length (mm)	3.24±22.55	9.56±19.34	0.379
	From upright to maximum right lateral flexion	Thoracic (°)	15.88±8.40	18.56±4.96	0.256
		Lumbar (°)	11.71±6.56	12.94±8.67	0.638
		Sacral (°)	2.18±5.81	3.44±3.63	0.442
		Pelvic inclination (°)	15.06±5.64	17.94±6.82	0.183
		Length (mm)	5.35±22.08	19.06±26.04	0.104
	From maximum left flexion to maximum right flexion	Thoracic (°)	28.82±10.466	31.61±8.82	0.399
		Lumbar (°)	18.76±8.197	18.83±12.21	0.985
		Sacral (°)	10.00±7.632	15.28±7.95	0.054
		Pelvic inclination (°)	31.71±10.687	38.06±11.25	0.097
		Length (mm)	2.12±24.349	9.50±21.17	0.345

CNP: chronic neck pain, *p<0.05

When the spinal posture values in the frontal plane were compared, the mean thoracic angle and the vertebral column length were higher in the CNP group than the control group in maximum left lateral flexion (p=0.040 and p=0.014, respectively). Additionally, the mean thoracic angle was lower in the CNP group than the control group in the maximum right lateral flexion (p=0.006) (Table 2).

According to the spinal mobility values in the sagittal plane, the mean pelvic inclination angle was lower in the CNP group than the control group from the upright position to the flexion movement (p=0.023). In addition, the lumbar and pelvic inclination angles were lower in the CNP group than the control group from the maximum extension to the maximum flexion movement (p=0.017 and p=0.013, respectively). There was no statistical difference between the CNP group and the control group in any spinal mobility values in the frontal plane (p>0.05) (Table 2).

DISCUSSION

According to the spinal posture results of this study, the length of the vertebral column in older adults diagnosed with CNP was higher than the age-matched control group in most of the positions, while the lumbar angle, pelvic inclination angle, and thoracic angle were lower. In addition, the pelvic inclination and lumbar angles in older adults diagnosed with CNP were lower than the age-matched control group in a few movements for spinal mobility. Moreover, the grip strength in older adults diagnosed with CNP was lower than the age-matched control group.

In CNP, decreased grip strength may occur for various reasons, such as muscle pain, weakness, circulatory disorders, and nerve compression. Loss of muscle strength, numbness, and tingling sensations due to decreased blood circulation or restricted neural transmission may cause difficulty in performing gross and fine motor functions in the hands (11). Tutar et al. reported that CNP significantly reduces grip strength measured by a handheld dynamometer in adults (19). Our study, which includes older adults, supports literature in this respect. It was known that the primary causes of CNP are myofascial pain and mechanical pain linked to improper posture (19). For this reason, the main reason for the difference in grip strength between older adults with and without CNP may be due to problems in spinal posture and spinal mobility.

Spinal mouse measurements are useful for measuring spinal posture and spinal mobility in situations with cost and time constraints. In a study conducted on adults with and without CNP, evaluating spinal posture and mobility with a spinal mouse, the thoracic angle was higher, and spinal mobility was lower in the adults with CNP than the adults without CNP (18). Another study conducted with adults revealed that CNP negatively affects the upper thoracic angle, and it was also emphasized that the presence of neck discomfort is more accurately predicted by the upper thoracic angle than the cranio-vertebral angle (20). Regarding thoracic angle and spinal mobility results, our study is consistent with the literature and indicates that the area affected by CNP is not only limited to the thoracic region but also includes the lumbar region. From these findings, it can be concluded that CNP causes changes in not only the thoracic but also the lumbar spine in the long term because the poor or compensated posture of the spine can exert significant pressure on the surrounding muscles and ligaments, hence impacting spinal stability. It can also cause tension and fatigue in the surrounding structures, often leading to more pain (21). The results of our study also showed that pelvic inclination in the maximum flexion and maximum extension position, from the upright to flexion movement, and from maximum extension to maximum flexion movement of the older adults with CNP were lower than the older adults without CNP. This situation reveals the restrictive effect of CNP, which generally becomes more severe as spine position and movement progresses. According to the results of our study, older adults with CNP may tend to perform more limited spinal movements compared to the older adults without CNP.

The relationship between vertebral column length and CNP is not well-established in current literature. The correlation between vertebral column length and neck pain is multifactorial, encompassing factors such as posture, biomechanics, spinal health, and muscular function (22,23). The development of neck pain can be influenced by the length of the vertebral column, especially the cervical spine. While variations in vertebral column length can influence posture and biomechanics, there is limited direct evidence linking overall vertebral length to the development or severity of CNP. Abnormalities in the cervical spine's curvature, such as a reduction or loss of the normal lordotic curve, have been linked to neck pain (24). Posture can be influenced by the cervical spine's length and alignment. Pain may result from misalignment or strain on the muscles and ligaments of the neck if the vertebral column is longer or shorter than the average. In our study, the vertebral column length was higher in older adults with CNP than without CNP in all positions except the maximum flexion position. A longer vertebral column may result in increased stress on the neck muscles and discs, particularly when there is poor posture, which can contribute to neck pain. Vertebral column length may be a predictor of CNP. However, further studies are needed on this topic.

This study has some limitations that the spinal posture and spinal movement of the cervical region and fine motor skills could not be evaluated. Further studies are needed to examine the comparisons of the results via pinch meter for fine motor skills and advanced imaging modalities for spinal posture and spinal mobility in older adults with and without CNP.

In addition to the changes in the thoracic region, the fact that CNP shows changes in the lumbar region, such as decreased lordosis angle and mobility, can be seen as a strength of our study. The restrictive effect of CNP on flexion and extension movements should be considered in the approach and treatment of these patients.

CONCLUSION

This study demonstrated that the length of the vertebral column and the grip strength were higher in the older adults diagnosed with CNP than the older adults without CNP; however, the lumbar angle, pelvic inclination angle, and thoracic angle were lower in the older adults diagnosed with CNP than the older adults without CNP according to the spinal posture measurements. The pelvic inclination angle and lumbar angle in older adults with CNP were lower than in older adults without CNP, according to the spinal mobility measurements. We recommend that further studies should evaluate the length of the vertebral column, grip strength and, spinal posture and spinal mobility of all the vertebral column parts in older adults diagnosed with CNP to understand the pathophysiology of CNP and biomechanical effects on cervical region.

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