
Isometric Endurance of Neck Muscles and Muscles for Scapular Positioning in Individuals with and without Postural Neck Pain

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BACKGROUND AND PURPOSE

Postural neck pain results from poor posture, arising through the sustained, long term, abnormal physiological loads imposed on the neck with a consequent reduction in neck and scapular muscle strength. The purpose of this study was to compare isometric muscle endurance in the neck and scapulothoracic region in individuals with and without postural neck pain. **Methodology:** Twenty-five patients between 20 to 50 years old with postural neck pain were chosen from the out-patient departments of Srinivas College of Physiotherapy and Rehabilitation Centre and Government Wenlock Hospital, Mangalore, and 25 healthy age matched individuals from society. The Neck Disability Index (NDI) for patients, isometric Neck Flexor Endurance (NFE), Scapular Muscle Endurance (SME), Neck Extensor Endurance (NEE), and pain using a visual analogue scale (VAS) for subjects in both groups were measured. **Results:** Highly significant differences in NFE ($t = -7.704$ and $p < 0.001$) and SME ($t = 6.147$ and $p = 0.05$) while no significant difference in NEE ($t = -13.027$ and $p > 0.05$) were found between symptomatic and asymptomatic groups. Furthermore, correlations were found between NFE and VAS ($r = 0.521$), NEE and NDI ($r = -0.709$), and NEE and VAS ($r = -0.411$) while no correlation ($p > 0.05$) was found between SME and VAS ($r = 0.051$), NFE and NDI ($r = 0.163$), and SME and NDI ($r = -0.110$). **Conclusion:** It is concluded that there is a significant decrease in isometric endurance of neck muscles and muscles for scapular positioning in neck pain patients. Pain and disability are the significantly affecting factors of isometric endurance of neck muscles and muscles for scapular positioning in postural neck pain patients.

INTRODUCTION

Musculoskeletal pain constitutes mainly back pain, neck pain, shoulder pain, carpal tunnel syndrome, tenosynovitis, etc. in order of prevalence rate.¹ The cervical spine is the most mobile part of the vertebral column. It is estimated that the osseoligamentous system contributes to 20% of the cervical spine's mechanical stability, while 80% is provided by the surrounding neck musculature.² The ligaments' role in stabilization occurs mainly at end-of-range posture, while muscles supply dynamic support in activities around the neutral and mid-range postures that are commonly used during functional daily tasks. The complex arrangement of muscles contributes to static and dynamic control of the head and neck. In the presence of injury or pathology, the role of the muscular system becomes even greater, which highlights the need to address the muscle system during both the assessment and rehabilitation of patients with neck pain.³

Neck pain is a common health problem that is associated with significant disability in the general population.⁴ Cross-sectional studies consistently reported that the prevalence of neck pain increases with age, and that it is higher in women. The incidence

of neck pain increased slightly with age and peaked between the ages of 30 and 45 years.⁵ The higher prevalence of chronic neck pain in older individuals and in women suggests that the prognosis of neck pain varies with age and gender.⁶

Some estimates suggest that 67% of individuals will suffer from neck pain at some stage throughout their life. With an increasingly sedentary population, especially with the reliance on computer technology at the work place, it is predicted that the prevalence rate will continue to rise.⁷

Neck pain may arise from any of the innervated structures in the neck, such as intervertebral discs, muscles, ligaments, zygoapophyseal joints, duramater and nerve roots.⁸ Physical risk factors (such as prolonged sitting and neck flexion) have been identified as predictors of neck pain in the study of a mixed population of workers from various industries, health, and professional settings.⁹ Recurrent cervical spine pain is also related to physical and mental stress both at home and work.¹⁰ This in turn causes disability.¹¹

Postural neck pain is usually associated with sustained static loading of the cervical spine and shoulder girdle during occupational and leisure activities.¹² Postural neck pain results from poor posture, arising through the sustained, long term abnormal physiological loads that such postures impose on the neck with a consequent reduction in neck muscle strength.¹³ A higher incidence of the postural abnormality "forward head" (66%) was observed in the thoraco-cervical-shoulder region in a group of healthy subjects between the ages of 20 to 50 years.¹⁴ There is a positive association between neck pain and occupational sitting postures. In addition, patients with postural neck pain have been found to have an altered perception of "good" posture.¹²

A study by Szeto, Straker, and O'Sullivan found that office workers using computers had increased forward neck flexion compared to their relaxed sitting postures, and this forward flexion was more pronounced in symptomatic persons (about 13% more neck flexion). The consequence of increased forward neck flexion may result in an increased tension in the postural stabilizing muscles as well as increased compressive forces in the articulations of the cervical spine.¹⁵

Loading of the cervical spine may also be influenced by axioscapula muscle function. Co-ordinate activation of the trapezius and serratus anterior muscles is important to optimize scapular position and local transfer from the upper limbs to the cervical spine. Changes in the axioscapular muscles activity during low-load functional tasks have been shown in patients with chronic neck pain. These findings suggest that the key muscle groups involved in the maintenance of neck postures are the cervical flexors and extensor groups and the muscles that control the position of the scapula.¹² Therefore, muscle function is an important factor in understanding neck pain. Chronic neck pain is thought to be more common among women because their muscle strength is lower than that of men. The sustained muscle contraction required to hold the head in various positions and the fatigue resulting from muscular weakness are suspected of being causative factors in chronic neck pain. Patients with chronic neck pain may have low neck strength in flexion, extension, and rotation or in any combination of these.¹⁶

The association between neck pain, neck posture, and neck muscle endurance has been established. It has been demonstrated that there is a reduction in the strength and endurance capacity of the cervical flexor and extensor muscles in patients with neck pain.^{3,13,17-19} Furthermore, this weakness of the neck muscles contribute to persistent neck pain.¹³ Individuals with neck pain showed an altered muscular synergy in which the sternocleidomastoid and anterior scalene (superficial flexors) become proportionally more active than the deep flexors. Furthermore, decreased deep flexor endurance has been associated with increased cervical lordosis and cervical pain.²⁰

A number of studies have demonstrated a reduction in the strength and endurance capabilities of both deep and superficial cervical flexor and extensor muscles in patients with neck pain.^{13,17-18,20-21} Weakness of neck muscles has been proposed to contribute to persistent neck pain.¹³ Factors that influence posture such as postural awareness and muscle function may be deficient in this patient group. Scapular alignment is often associated with concomitant weakness of some or all portions of the trapezius as well as the rhomboids and levator scapulae. The potential result of these impairments is compressive loading of the cervical spine, resulting from a transfer of the weight of the upper extremities to the cervical region through the cervicoscapular muscle attachments.²²

To evaluate muscle function in the patient groups, the available tests of neck muscle endurance have focused predominantly on the flexor muscles or extensor muscles, and these tests have shown reliability in asymptomatic and symptomatic patients with neck pain.^{20,23-24} There has been little evaluation of tests for muscle endurance in the neck and scapula-thoracic region in individuals with postural neck pain. There are no published studies found in India in this respect for the Indian population. Therefore, the purpose of this study is to determine the isometric muscle endurance in the neck and scapula-thoracic region in

patients with postural neck pain using 3 different tests. The objectives of the study were to compare the isometric endurance of neck muscles and muscles for scapular positioning in postural neck pain patients and asymptomatic individuals and to correlate pain and disability with isometric endurance of neck muscles and muscles for scapular positioning in postural neck pain patients. So, it was hypothesized that, 1) there will be a significant decrease in the endurance of neck muscles in the postural neck pain patients, and 2) there will be a significant relationship between pain and disability and isometrics endurance of neck muscles and muscles for scapular positioning in the postural neck pain patients.

METHODOLOGY

Subjects

A sample of 50 subjects (25 neck pain patients and 25 healthy individuals) with age and gender matched were included for this cross sectional study. Patients diagnosed with postural neck pain for the experimental group were recruited from the outpatient department of Srinivas College of Physiotherapy and Research Centre, and Government District Wenlock Hospital, Mangalore. Age and gender matched healthy individuals were taken from the society as a control group.

The subjects were selected using a purposive sampling procedure. The purpose and procedure of the study were explained to all the subjects for maximum co-operation, and a written consent (approved by institution) was taken from them stating the voluntary participation in this study. Each subject was screened initially by using a simple selection tool relevant to the inclusion and exclusion criteria.

Patients with neck pain aggravated by functional activities that required sustained postures relieved by postural modifications and with symptom duration of greater than 3 months were included. Subjects with any pathology affecting cervical mobility or having any upper limb neurological symptoms were excluded from the study. Subjects who had participated in any form of specific strengthening of the neck and upper extremity musculature just before and during the tests and the subjects who could not understand the commands were also excluded.

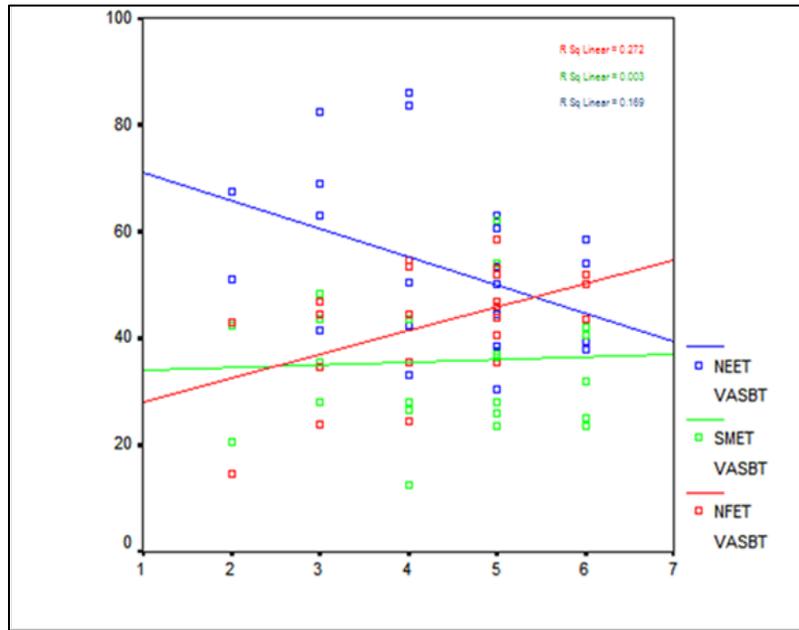
For the control group, volunteers were excluded from the study if they had current neck pain or had been under treatment for neck pain within the previous 6 months. Approval for the study was obtained from the Ethical Committee of the Srinivas Group Colleges along with each subjects' informed consent before testing. These selected subjects who were willing to participate were assigned into either Group 1-Experimental or Group 2-Control as per the criteria.

Outcome Measures

Neck Flexor Endurance

The NFE test was performed with the subject lying supine on the plinth (Figure 1). An air-filled pressure sensor (pressure bio-feedback - Chattanooga Group, Australia) was placed below the sub-occipital region and inflated to 20 mm Hg of pressure, which was sufficient to fill the space between the testing surface and the neck without pushing the neck into further lordosis. The patient was guided by the feedback from the pressure sensor to reach five sequential pressure targets in 2mm Hg increments from a baseline of 20 mmHg to 30 mmHg. Subjects were instructed to "gently nod their head as they are saying 'yes'." Verbal commands like "tuck your chin in" and "hold your head up" were given. The examiner identified the target level that subjects would have to hold for 10 seconds without resorting to retraction, without dominant use of the superficial neck flexor muscles, and without a jerky cranio-cervical flexion. Activation of the superficial neck muscles was monitored by the therapist in all stages using palpation or observation. The test was terminated at any of the stage if the subject was unable to maintain the position of the head. Neck Flexors Endurance (NFE) was measured as the holding time in seconds.¹²

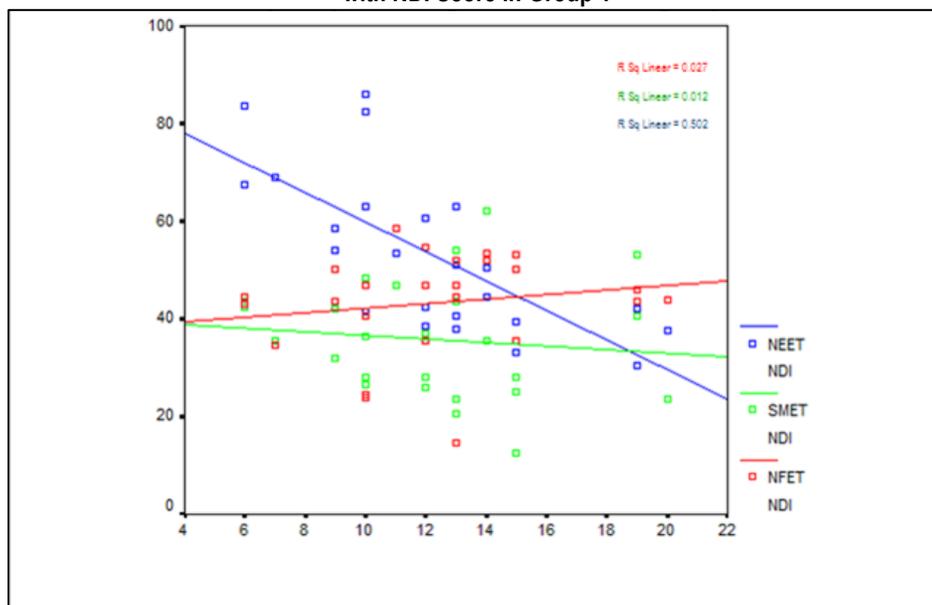
Figure 1. Correlation between Endurance of Neck Muscles and Muscles Scapular Positioning with VAS Score in Group 1



Scapular Muscle Endurance

The SME test was performed with the subject in a standing position (Figure 2). Subjects were requested to stand with their shoulders and elbows flexed to 90 degrees. A spring balance device was held between the subject's hands by holding the hooks attached to the device. The scapula was maintained in a neutral position, and a spacer was positioned between the subject's elbows to maintain the test position. The subjects were asked to externally rotate the shoulders to achieve a 1-kg load of pull that was as shown by movement of the needle in the spring device. The subjects were requested to maintain this force. The end point of the test was defined as when the subject was unable to maintain the set resistance, dropped the spacer, or failed to maintain 90 degrees of shoulder flexion. Scapular Muscles Endurance (SME) was measured as the holding time in seconds.¹²

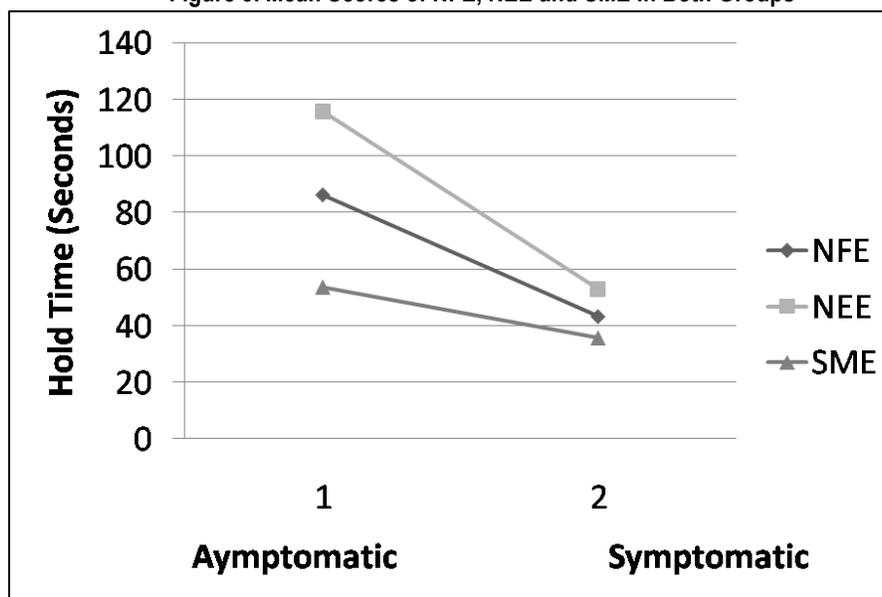
Figure 2. Correlation between Endurance of Neck Muscles and Muscles for Scapular Positioning with NDI Score in Group 1



Neck Extensor Endurance

The NEE test was performed with the subject positioned in prone lying on the plinth with their arms at their sides and their head over the end of the plinth (Figure 3). A strap was placed at the level of T6 around the plinth to support the upper thoracic spine. A velcro band was fixed around the head with a bubble inclinometer attached to the band over the occiput. A weight of 2 kg was suspended from the headband so that the weight is located just short of the floor. The subject's head was positioned in neutral in the sagittal plane, and the subject was asked to hold the cervical spine horizontal. The test was terminated if the weight returned to the floor or if the neck position changed as measured by the bubble inclinometer. Neck Extensors Endurance (NEE) was measured as the holding time in seconds.¹³

Figure 3. Mean Scores of NFE, NEE and SME in Both Groups



Pain

Pain was measured in the neck pain group subjects using a 10 point visual analogue scale where 0 (zero) represents “no pain” and 10 represents “worst pain ever.” The score was measured before and after the administration of muscle endurance tests.

Procedure

All subjects were selected for the study after they fulfilled the inclusion criteria. The information about the personal identification details, occupation, and current work status were collected using an assessment form. The selected patients who were willing to participate were assigned into Group 1 (experimental group) and the volunteers into Group 2 (control group). Subjects were asked to define a location of their pain using a body chart. Pain intensity was recorded before and after each testing occasion for the group-1 participants. Furthermore, information about the impact of the postural neck pain on physical and psychological functions was measured using NDI as described previously.²⁵

All subjects in group 1 and group 2 were made to perform the 3 muscle endurance tests which included the Neck Flexor Endurance test, the Neck Extensor Endurance test, and the Scapular Muscle Endurance test. The subjects completed each test twice. Each subject was given a 3-minute rest between each test and a 20-minute rest between the 2 sets of tests. The mean score of these two attempts were used for the interpretation.

Data Analysis

The data were collected by using a data collection form. Then the data collected was presented in the tabular form for all the parameters. Mean, standard deviation, standard error, and Karl Pearson Product Moment Coefficient (r) were calculated to determine the relation of VAS score, Neck Disability Index (NDI), and neck pain duration with the Neck Flexor Endurance test, the Scapular Muscle Endurance test, and the Neck Extensor Endurance test in the group-1 subjects.

A Multivariate Analysis of Variance was performed to compare the endurance of neck flexors, neck extensors, and muscles for scapular positioning between the groups, i.e. neck pain group and asymptomatic group. The level of significance was set at

$P < 0.05$ for analysis. Descriptive statistics were used to plot the demographic characteristics. All statistical analyses were performed using the software SPSS version 20.0.

RESULTS

Fifty subjects were screened for this study. Three endurance tests were performed on the subjects. Out of 25 neck pain patients, 9 were male patients and 16 were female in experimental group while in the control group, 10 were males and 15 were females. Table 1 shows the demographic characteristics and the neck pain symptoms. The mean age of the participants in the symptomatic and asymptomatic group were 29.6 ± 7.85 years, and 25.2 ± 2.29 years respectively. The mean pain score for the symptomatic group participants was 4.44 ± 1.227 out of 10 points in the VAS score with the minimum pain score of 2.00 and maximum pain score of 6.00. The mean duration of the neck pain symptoms for the symptomatic group participants was 13.62 ± 9.37 months with the minimum duration of 3 months and maximum duration of 36 months. The mean perceived disability score on NDI due to the neck pain for the symptomatic group participants was 12.28 ± 3.71 with the minimum score of 6.00 and maximum score of 20.00.

Table 1. Demographic Characteristics and Neck Pain Symptoms

Variables	Group	N	Mean	SD	Minimum	Maximum
Age	Symptomatic	25	29.6	7.84750	20.0	50.0
	Asymptomatic	25	25.2	2.29129	21.0	31.0
Duration	Symptomatic	25	13.6200	9.37337	3.00	36.00
Pain score (VAS)		25	4.4400	1.22746	2.00	6.00
NDI score		25	12.2800	3.71394	6.00	20.00

Comparison of Neck Flexor, Extensor, and Scapular Muscle Endurance between Groups

All the subjects were at least able to commence the neck muscle endurance test, but success in the test with a 10-minute goal varied between groups. Individual holding times are shown in Figure 3. A highly significant difference was found in neck flexor endurance ($t = -7.704$, $p < 0.001$) between symptomatic and asymptomatic groups. No significant differences were found in scapular muscle endurance ($t = -6.147$ and $p = 0.05$) and in neck extensor endurance ($t = -13.027$, $p > 0.05$) between symptomatic and asymptomatic groups. (Table 2)

Table 2. Inter group Comparison of Neck Flexor, Extensor and Scapular Muscle Endurance between Symptomatic and Asymptomatic Individuals

Para-meter	Group	N	Mean	SD	95% CI		F value	p level
					Upper	Lower		
NFE (secs)	Symptomatic	25	43.30	10.43	35.394	51.206	59.348	0.000**
	Asymptomatic	25	86.14	25.78	78.234	94.046		
SME (secs)	Symptomatic	25	35.78	11.91	31.663	39.897	37.787	0.000**
	Asymptomatic	25	53.58	8.24	49.463	57.697		
NEE (secs)	Symptomatic	25	52.82	15.84	45.946	59.694	169.696	0.000**
	Asymptomatic	25	115.80	18.27	108.93	122.67		

** - Highly significant

Correlation between VAS, NDI scores and the Duration of symptoms with the Muscle Endurance in Experimental Group

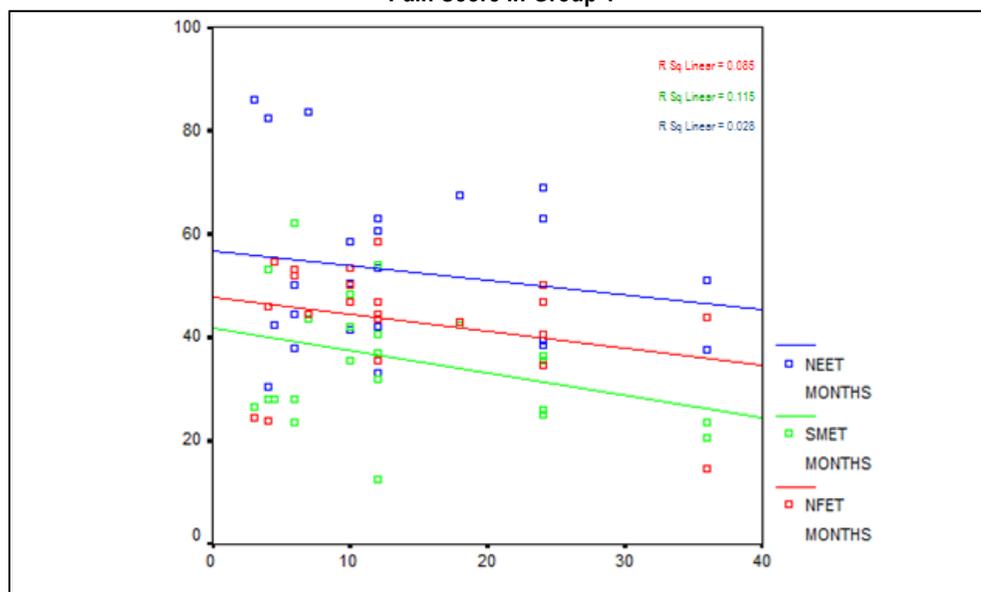
There was a moderate correlation (Table 3) between NFET score and VAS score ($r = 0.521$ and $p = 0.008$), while there was no correlation (Figure 1) found between SMET score and VAS score ($r = 0.051$ and $p = 0.808$). In addition, a negative correlation was found between NEET score and VAS score ($r = -0.411$ and $p = 0.0411$). At the same time, while correlating the Neck Disability Index score neck and scapular muscle endurance, no correlations were found between NFET score and NDI score ($r = 0.163$ and $p = 0.437$), and between SMET score and NDI score ($r = -0.110$ and $p = 0.602$). However, a negative correlation was found between NEET score and NDI score ($r = -0.709$ and $p = 0.000$). (Figure 2) Furthermore, poor negative correlations were found between NFET, NEET, and SMET with duration of the neck pain symptoms. (Figure 4)

Table 3. Correlation between Endurance of Neck Muscles and Muscles for Scapular Positioning with VAS Score and NDI Score in Group 1

Parameters	N	Interpretation	VAS	NDI
NFET	25	r value	0.521**	0.163†
		Sig	0.008	0.437
SMET	25	r value	0.051	-0.110†
		Sig	0.808	0.602
NEET	25	r value	-0.411*	-0.709**
		Sig	0.041	0.000

*Correlation is significant at $p < 0.05$ level **Correlation is significant at $p < 0.01$ level

†No Significant Correlation with $p > 0.05$ level

Figure 4. Correlation between Endurance of Neck Muscles and Muscles for Scapular Positioning with Duration of Neck Pain Score in Group 1

DISCUSSION

Postural neck pain is usually associated with sustained static loading of the cervical spine and shoulder girdle during occupational or leisure activities.¹² Previous studies have focused predominantly on the flexor muscles or extensor muscles, and these tests have shown reliability in patients with neck pain as well as asymptomatic subjects.^{12,20} There has been little evaluation of tests for muscle endurance in the neck and scapulothoracic region in individuals with postural neck pain.¹² So in this study, efforts were made to compare the isometric endurance of neck muscles and muscles for scapular positioning between postural neck pain patients and asymptomatic individuals. The study also aimed to correlate pain and disability with isometric endurance of neck muscles and muscles for scapular positioning in postural neck pain patients.

The Neck Flexor Endurance test, Scapular Muscle Endurance test, and Neck Extensor Endurance test (ICC 0.93, 0.67 and 0.88 respectively) were used in neck pain patients and control subjects.¹² In the short duration, all the 3 tests were performed by all the subjects. The neck extensor endurance test used was based on the low-back extensor test described by Biering-Sorensen and the Neck Extensor Endurance test.²⁶⁻²⁷ There was a tendency for the asymptomatic subjects to perform better than the symptomatic subjects. Jari Ylinen et al had found that the group with neck pain has lower neck muscle strength in all directions tested than the control groups.¹⁶

Some studies have reported that subjects with neck pain had a tendency to demonstrate lower neck muscle endurance than the subjects without neck pain.²⁷ It has been theorized that because the tonic function of the deep cervical flexors are compromised, further dysfunction occurs within the cervical mechanism, and a cycle of pain and weakness is established.²⁸ It was found that neck muscle endurance was decreased in neck pain patients when compared with control subjects. Among those patients, 35% to 100% had NME disability, with most of them were having a lower rate than the 95% confidence interval of controls.²⁹ The

mean score for NFE obtained in neck pain group in this study was 43.30 seconds. In a previous study on neck pain individuals, the mean score for this test was 50.00 seconds.¹²

The results of this study showed a highly significant difference in NFE between symptomatic (mean 43.30) and asymptomatic (mean 86.14) groups. Other researchers also have reported similar results, i.e., a significant reduction of neck muscle strength in neck-pain subjects.³⁰⁻³¹ The reason for the lesser hold time in this study can be that maintaining the head position and upper neck flexion was assisted using only verbal feedback, whereas others used both verbal as well as tactile feedback. This feedback might have helped to reduce the problems with kinesthetic awareness and provide a more accurate measure of endurance capacity.

Like this present study, a similar study conducted for the performance of craniocervical test in subjects with and without neck pain demonstrated that the patients with chronic neck pain had poorer ability to perform the CCFT compared with asymptomatic subjects.²⁴ Jull et al also found a significant reduction in deep neck flexor performance in a group of patients with neck pain.³² The reduced performance of the craniocervical flexion test is associated with the dysfunction of the deep cervical flexor muscles and support the validity of this test for patients with neck pain.³³ In contrast to these findings, a previous study found no difference between groups in the flexor test holding time (neck pain = 36 s, controls = 38 s) ($p = 0.96$).³⁴

The mean score for NEE obtained in neck pain patients in our study was 52.82 seconds. The neck extensor endurance tests both with and without the addition of external load has been described previously.²⁹ However, our study used the loaded test where a weight of 2 kg was used. Edmondston found the mean score for NEE in neck pain patients to be 141.66 seconds.¹² Even Lee et al found the endurance of neck extensor muscles lower in pain groups.¹³ A few more studies also have compared neck strength for symptomatic and asymptomatic subjects.^{27,35} Moreover, those comparisons had required the use of expensive equipment.³⁶⁻³⁷ In the current study, a simple and inexpensive test was used using a modified version of the Biering-Sorensen low-back extensor test.

The reported neck muscle endurance times were significantly lower in both treated and untreated neck-pain groups when compared with the no-pain group ($F = 25.87$, $P < .001$; $F = 8.76$, $P = .006$, respectively).¹³ A highly significant difference in NEE ($F = 169.696$ and $p = 0.000$) was found between symptomatic (mean 52.82) and asymptomatic (mean 115.80) groups in this study. A study by Lee, Nicholson, and Adams demonstrated a decrease in neck extensor muscle endurance which was greater in individuals who had sought treatment than those who had not.¹³ Likewise, a decrease in neck flexor and extensor muscle endurance had been reported in patients with non-specific neck pain compared to asymptomatic subjects.²⁹ Subjects in the untreated-pain group who could not reach the target time tended to cease the test because of muscle fatigue, whereas treated-pain group subjects tended to cease because of pain.¹³

Impaired function in the axioscapula muscles may lead to altered patterns of load transfer in the cervical spine.³⁸ The mean score for SME in neck pain patients in our study was 35.78 seconds. Edmondston et al found the mean score for SME in neck pain patients to be about 53.66 seconds.¹² This test was based on an exercise described earlier, designed to improve performance of the serratus anterior and trapezius muscles.³⁸

Furthermore, there was a significant difference found in SME between symptomatic (35.78) and asymptomatic (53.58) groups. Chiu et al also demonstrated that neck muscles weakness was common in patients with chronic neck pain, and that those patients may tend to develop an increased cervical lordosis posture associated with a forward head posture that leads to neck extensor muscle faulty biomechanics.¹⁸ McKenzie also proposed that non-specific neck pain results from poor posture along with consequent reduction in neck muscle strength. However, there is conflicting evidence for their proposed causative relationship between neck pain and neck muscle endurance.³⁹

In contrast to all these findings, patients with postural neck pain were not found to have significant impairment of neck muscle endurance or accelerated fatigue compared to control subjects. The median extensor test holding time was lower but not significantly different in the neck pain group (165 s) than the control group (228 s) ($p = 0.17$).³⁴ The mean VAS score pre-test was 4.44 and 5.12 post-test. All the subjects were able to complete the 3 tests on each testing occasion. There was a small but significant increase ($t = 5.421$, $p < 0.001$) in the pain intensity after each testing occasion compared to pre-test baseline measure of the symptomatic subjects. Edmondston et al also reported a small increase in the pain intensity after each testing occasion compared with pre-test measures.³⁴ But in this study, in most of the subjects, the test was terminated due to the inability to hold the position rather than an increase in pain intensity. The existing weakness or inability of the muscles to execute the endurance capacities might be the reason for the decreased holding time, and further, the stress put on the already weak muscle might be the reason for the increased pain after the testing.

Currently, the associations between neck pain, neck posture, and neck muscle endurance have not been firmly established. The second objective of our study was to correlate pain and disability with the isometric endurance of neck muscles and muscles for scapular positioning in postural neck pain patients. The results showed that there is a moderate positive correlation between NFE and VAS ($r = 0.521$ and $p = 0.008$), which in turn shows that neck flexor endurance is related to the pain in the cervical spine. An earlier study also established the fact that poor endurance of the neck extensor muscle has been associated with neck pain.³⁵ However, no correlation was found between SME and VAS ($r = 0.051$ and $p = 0.808$), evident the fact that neck pain does not affect the scapular positioning muscles' endurance. This explains the less stressful muscle activity. A negative low correlation existing between NEE and VAS ($r = -0.411$ and $p = 0.0411$) in this study shows that the neck extensor endurance is affected by neck pain. Grimmer and Trott also failed to show an association between the deep short flexor endurance of the neck and neck pain in their population-based study.⁴⁰ But Grant et al, using a different measurement protocol, reported an association between them.⁴¹ Another study also found no significant associations between neck disability, jaw disability, clinical variables, and neck flexor endurance test.⁴²

There were no correlations between NFE and NDI ($r = 0.163$ and $p = 0.437$), and between SME and NDI ($r = -0.110$ and $p = 0.602$). However, a moderate negative correlation was found between NEE and NDI ($r = -0.709$ and $p = 0.000$). In contrast to these findings, a previous study found asignificant negative correlation ($P < .02$) between NME and Neck Disability Index, except for ventral NME in patients with neck pain before treatment.³⁰

Therefore, our study found that there is a significant reduction in isometric endurance of neck muscles and muscles for scapular positioning in neck pain patients when compared with the asymptomatic group. Furthermore, the pain and disability are correlated with the isometric endurance of neck muscles and not correlated with the muscles for scapular positioning in postural neck pain patients. The study had certain limitations in terms of a smaller number of samples taken for the study and only two trials included in this study.

Future studies may include electromyographic (EMG) analysis to explore the muscular activity in the shoulder and neck, and the testing should be done along with the effect of treatment options also. Moreover, a measure of subject effort using the Borg Scale would be a useful modification to the current study.

CONCLUSION

From the statistical findings, it is concluded that there is a significant decrease in isometric endurance of neck muscles and muscles for scapular positioning in neck pain patients when compared with an asymptomatic group. Furthermore, it is understood that the pain and disability are the significantly affecting factors of isometric endurance of neck muscles and muscles for scapular positioning in postural neck pain patients. This data suggests that neck and scapular muscle endurance may be the useful measurements to distinguish between groups with and without neck pain.

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KEY TERMS

Postural Neck Pain, Neck Muscle Endurance, Scapular Muscle Endurance, Chronic Neck Pain, Neck Flexor Endurance Test, Neck Extensor Endurance Test