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Original Research Article

Effectiveness of Selected Exercise Programme on Cervical Range of Motion in Patients with Thoracic Kyphosis & Forward Head Posture

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ABSTRACT

Background: Altered postural behaviours result in Forward head posture and thoracic kyphosis making it amenable to correction. The biomechanical strain, in presence of reduced strength of the core stabilizing musculature, in particular, if it is repeated or prolonged, is the predominant explanation for symptoms associated with forward head posture and thoracic kyphosis i.e., neck pain and reduced cervical range of motion.

Objective: The aim of the present study was to investigate and compare the effect of postural awareness and conventional exercises on the cervical range of motion in patients with thoracic kyphosis and forward head posture.

Methodology: This experimental study was conducted on 60 subjects both male and female of age group 20-35yrs. Subjects were randomly divided into two groups consisting of 30 subjects each. Group A received hot pack and postural advice and Group B received hot pack and stretching and strengthening exercises. All the subjects received a total intervention of 4 days (alternate days) per week for 4 weeks.

Results: Intra-group significant differences were obtained between pre- and post-treatment for all evaluated variables (pÂ0.01) in both groups. The inter-group comparison showed significant differences (pÂ0.01) between post-treatment variables of Group A and Group B where, Group B showed greater improvement than Group A.

Conclusion: The treatment given to both the groups together can be used to improve cervical range of motion, thoracic kyphosis, and forward head posture. This study may serve as a guideline for physiotherapists when making decisions regarding possible interventions.

KEY WORDS: Cervical range of motion, Craniovertebral angle, Forward head posture, Kyphosis index, Neck disability index, Thoracic kyphosis.

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INTRODUCTION

Forward head posture (FHP) is a head-on-trunk misalignment and is described (in sitting or standing) as 'any alignment in which the external auditory meatus is positioned anterior to the plumb line through the shoulder joint [1]. According to the literature, FHP changes the biomechanical stress on the cervical spine and leads to musculoskeletal disorders for instance cervical pain, headache, temporomandibular and muscular dysfunctions [2].

This posture encompasses weakness in the mid-thoracic scapular retractors (i.e., rhomboids, serratus anterior, middle and lower fibers of the trapezius) and deep cervical short flexor muscles and shortening of the opposing cervical extensors and pectoralis muscles (known as the upper crossed postural syndrome) [3]. Although there is a unanimity that the prolonged adoption of FHP can result in this muscle results from habitual postures assumed over time (e.g., working postures), thus making it amenable to correction through exercise [4]. In FHP the centre of gravity of the head is anterior to the vertical axis (often measured by a plumb line), thereby increasing the load on posterior neck muscles. This biomechanical strain, in the presence of reduced strength of the core stabilizing neck musculature, in particular if it is repeated or prolonged, is the predominant explanation for symptoms associated with FHP [5]. It has been shown by the previous studies that forward head posture results in shortening of the posterior neck extensors, tightening of the anterior neck and shoulder muscles, and affects scapular position and kinematics. In addition to muscle imbalance, FHP has been linked to pain, fatigue and restricted movement of the neck along with symptoms attributed to excessive joint and muscle loading [6].

Excessive thoracic curvature of the spinal column (Hyper kyphosis deformity) is one of the most common postural abnormalities and is one of the most important causes of the upper quarter pathology [7]. Spinal abnormalities in individuals with completed skeletal growth have been reported at an estimated 32% prevalence in adults and a prevalence of 60% in the elderly [8]. Early detection, correct assessment, sufficient cure and rehabilitation, prevention and suitable active exercises may impede effects of postural abnormalities. Although improvement in postural alignment secondary to exercise would be expected due to improvement in muscle length and strength, the influence of self-awareness of posture must also be taken into consideration. There is widespread inclusion of postural correction in therapeutic interventions but experimental data to support its effectiveness is limited [9].

Early detection, correct assessment, sufficient cure and rehabilitation, prevention, and suitable active exercise may impede different effect of postural and spinal deformities.

To some extent, postural correction is under our conscious control, so a program that has postural assessment and exercises specially designed to improve posture could increase the postural awareness of participants and potentially change their habitual postures. Despite of the fact that widespread inclusion of postural correction in therapeutic interventions is there, experimental data to support its effectiveness is limited [9].

METHODS

The present study was experimental in nature. The study was done in the Department of Physiotherapy, Guru Nanak Dev University, Amritsar.

Ethical Approval and Consent: Before the study began, ethical approval was obtained from the institutional ethical committee (vide letter No. (225/HG) dated 27/09/2018). Prior to the commencement of the study, each participant was explained the purpose, aims, objectives and risks associated with the study and thereafter their written consent was obtained.

Participants: Sixty adults (mean [SD] age = 27.95±4.24 years), both male and female were included and divided into 2 groups using random sampling technique. Subjects having forward head posture and thoracic kyphosis, cervical pain- with/without referred pain, numbness or paraesthesia, pain and functional difficulty of some extent for at least 1 week participated. Subjects were excluded if they had a history of spinal or lower limb fractures, neuromuscular disorder, moderate and severe scoliosis, visual impairment not corrected by prescriptive lenses, whiplash injury, dizziness, foot deformities, history of falls over the past one year, or significant impaired function due to their lower back or lower limbs that would overshadow their neck pain and affect their standing posture.

Anthropometric Variables: Three anthropometric variables namely height, weight and BMI were measured from all the subjects using the standard techniques [1] and were measured in triplicate with the median value used as the criterion. Stadiometer (Holtain Ltd. Crymych, Dyfed, UK) was used for measuring standing height. Subjects were weighed in minimal light-weight clothing, bare foot, using standard weighing machine (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. Body mass index (BMI) was calculated from height and weight as follows: BMI=weight (kg) / height2 (m2).

Treatment Protocol

Group A: Group received hot pack for 15min and Postural advice. Patients had to follow the postural advice throughout the four week session and had to perform the advised changes during their usual work routine. It included: 1. To Decrease a Forward Head Posture: [10] (a) Axial Extension (Cervical Retraction) and (b) Scapular Retraction and 2. Stress Management/Relaxation: (a) Cervical and Upper Thoracic Region and (b) Lower Thoracic Region

Table A: Treatment protocol for Forward Head Posture [5]:

Exercises	Progression 1	Progression 2	Progression 3	Progression 4
Strengthen Deep Cervical Flexors	Lying chin tuck	Lying chin tuck with head lift	Lying chin tuck with head lift*	Lying chin tuck with head lift*
Stretch Cervical Extensors	Chin drop	Chin drop with hand assistance	Chin drop	Chin drop with hand assistance
Strengthen Shoulder Retractors	Standing shoulder pull back with elastic resistance	Shoulder pull back with weight Left and Right side	Shoulder pull back with elastic resistance and weight Left and Right side	Shoulder pull back with elastic resistance and weight Left and Right side
Stretch Pectrolis Muscle	Pectoral stretch Left and Right side	Bilateral Pectoral stretch	Pectoral stretch Left and Right side	Bilateral Pectoral stretch

*Progressions were done with 2-second hold starting at 2 seconds i.e., 2, 4, and 6 seconds. (In some cases, if patients were unable to progress by 2 seconds, but rather by 1 second)

Group B: Group received hot pack for 15min and exercises for forward head posture and thoracic kyphosis. The treatment program was performed four days per week (Alternate days) for four weeks. Each treatment session lasted for about an hour. (Table A and Table B)

Table B: Treatment protocol of Thoracic Kyphosis [10].

Exercises	Progression 1	Progression 2	Progression 3	Progression 4
Stretch upper thoracic region*	Pectoralis major stretch	Increase flexibility of anterior thorax	Pectoralis major stretch	Increase flexibility of anterior thorax
Extension exercises for lower thoracic spine**	Prone press-up	Prone Press-up	Prone Press-up	Prone Press-up

*Stretch held for 30 seconds and 3 sets of 12 repetitions.

**3 sets of 12 repetitions starting at 5 seconds and progressed by 5-second holds i.e., 10, 15, and 20 seconds. The initial hold time of the stretch was dependent on the patient's ability.

Outcome measures:

Neck disability: The Neck disability index (NDI) is a condition-specific disability measure. The NDI contains 10 items (7 related to activities of daily living, 2 related to pain, and 1 item related to concentration). Score of each item is ranges 0 to 5 and the total score is expressed as a percentage, with higher scores represents the greater disability [11].

Range of motion: Neck Range of motion was measured in a sitting position to remove errors and movement compensation. A large Universal goniometer was used for measuring the range of motion. The range of motion in all six directions was measured [12].

Thoracic kyphosis- Kyphosis index: Thoracic kyphosis was measured using the flexicurve method. Subjects were instructed to stand in their usual posture whilst we place the flexicurve over the spinous processes of the thoracic and lumbar spine. The ends of the flexicurve aligning according to C7 and S2 spinous processes and the shape of the flexicurve conform the curvature of the spine.

Next, the flexicurve was carefully placed on paper and its outline traced. A straight line drawn from the ruler position of C7 to S2 that corresponded to the length of thoracic kyphosis calculated as described below. The kyphosis index is calculated from thoracic width (B) divided by the horizontal length (L) multiplied by 100 (B/L x 100) (Fig.1). In our study, three measurements were obtained and the average was used in the data analysis [13].

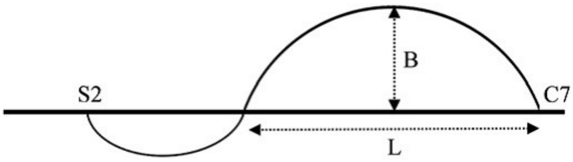

Fig. 1: Representation of measurement of kyphosis Index.

Forward head posture: A digital imaging technique was used to evaluate FHP posture in the standing position. A digital camera (Samsung SM-A307FN) was used. The height of the camera was adjusted to the level of the subject's shoulder and a self- balanced position was chosen to standardize the head and neck posture of subjects. The necessity of remaining in natural posture during taking photographs was explained by the assessor. Lateral-view photographs of the subject in his/her usual standing posture were used for assessing FHP. Lateral views of each subject were photographed to measure the craniovertebral angle (CVA) which is defined as the angle between the horizontal line passing through C7 and the line extending from the tragus of the external auditory meatus to C7. Notably, lesser CVA indicates greater FHP. [13] (Fig. 2)

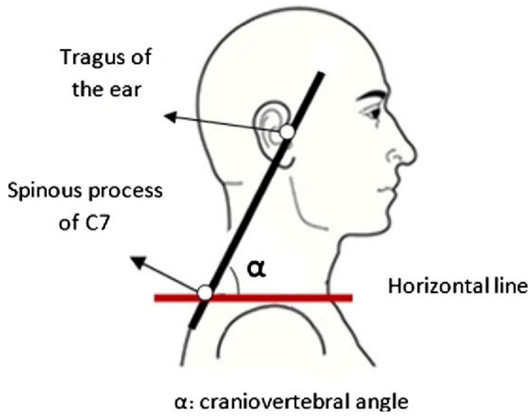

Fig. 2: Representation of measurement of Craniovertebral angle.

Data Analysis: The data collected was entered in EXCEL sheet and statistical analysis was done using SPSS (20.0) package (SPSS Inc. Chicago, USA). Inter-group and Intra-group comparison was done using paired t-test. The level for statistical significance was set at $p < 0.05$.

Table 1: Descriptive statistics of anthropometric variables.

Variables	Group A		Group B		t-value	*p* -value
	Mean	SD	Mean	SD		
Age (years)	26.93	4.44	28.96	3.82	1.898	0.63*
Height (cm)	164.5	8.32	164.76	6.75	0.136	0.892*
Weight (Kg)	59.1	9.68	58.83	8.87	0.111	0.912*
BMI (Kg/m2)	21.7	2.29	21.8	2.29	0.112	0.911*

*Non-significant (*P* >0.05)

SD: standard deviation; p-value: probability value; Significant at level (p<0.05)
Rt. = Right; Lt. = Left; BMI= Body mass index

Table 2: Descriptive statistics of different pre-treatment variables (Inter-group) of Group A and Group B.

Variables	Group A		Group B		t-value	*p* -value
	Mean	SD	Mean	SD		
AFROM (Degree)	36.03	3.45	35.3	3.15	0.858	0.394*
AEROM (Degree)	45	3.57	45.3	4.09	0.302	0.763*
ALF(Rt) (Degree)	35.33	3.05	35.36	2.85	2.575	0.364*
ALF(Lt) (Degree)	36	2.8	35.16	3.41	1.033	0.306*
ARROM(Rt) (Degree)	63.7	4.52	63.6	3.04	0.095	0.636*
ARROM(Lt) (Degree)	61.4	4.78	61.56	4.66	4.232	0.712*
KI	21.42	2.4	21.19	2.04	0.4	0.691*
CVA (Degree)	37.63	2.8	37.7	2.91	0.09	0.928*
NDI	36.23	2.62	36.2	2.51	0.05	0.960*

*Non-significant (*p* >0.05)

SD: standard deviation; p-value: probability value; Significant at level (p<0.05)

Rt. = Right; Lt. = Left; NDI= Neck Disability Index; AFROM= Active flexion range of motion; AEROM= Active extension range of motion; ALF= Active lateral flexion; ARROM= Active rotation range of motion; KI=Kyphosis Index; CVA= Craniovertebral angle; NDI= Neck disability index

Table 3: Descriptive statistics of different variables between pre-treatment and post-treatment of Group A:

Variables	Pre-treatment		Post-treatment		t-value	*p* -value	Percentage increment
	Mean	SD	Mean	SD			
AFROM (Degree)	36.03	3.45	40.9	3.11	28.445	0.001***	13.51%
AEROM (Degree)	45	3.57	49.4	2.59	12.775	0.001***	9.77%
ALF(Rt) (Degree)	35.33	3.05	38.7	2.36	7.089	0.001***	9.53%
ALF(Lt) (Degree)	36	2.8	38.7	2.32	11.012	0.001***	7.50%
ARROM(Rt) (Degree)	63.7	4.52	70.8	3.06	15.327	0.001***	11.10%
ARROM(Lt) (Degree)	61.4	4.78	67.66	3.85	18.137	0.001***	10.19%
KI	21.42	2.4	18.19	2.07	20.818	0.001***	17.75%*
CVA (Degree)	37.63	2.8	42.16	2.5	21.845	0.001***	12.03%
NDI	36.23	2.62	27.86	4.63	17.016	0.001***	30.04%*

***Highly significant ($p \leq 0.001$) *Percentage Decrement

SD: standard deviation; p-value: probability value; Significant at level (p<0.05)

Rt. = Right; Lt. = Left; NDI= Neck Disability Index; AFROM= Active flexion range of motion; AEROM= Active extension range of motion; ALF= Active lateral flexion; ARROM= Active rotation range of motion; KI=Kyphosis Index; CVA= Craniovertebral angle; NDI= Neck disability index

Table 4: Descriptive statistics of different variables between pre-treatment and post-treatment of Group B:

Variables	Pre-treatment		Post-treatment		t-value	*p* -value	Percentage increment
	Mean	SD	Mean	SD			
AFROM (Degree)	35.3	3.15	44.46	2.94	23.171	0.001***	25.94%
AEROM (Degree)	45.3	4.09	54.9	3.5	20.267	0.001***	21.19%
ALF(Rt) (Degree)	35.36	2.85	42.06	1.77	16.267	0.001***	24.60%
ALF(Lt) (Degree)	35.16	3.41	42.46	1.67	9.744	0.001***	20.76%
ARROM(Rt) (Degree)	63.6	3.04	77.16	2.45	19.156	0.001***	21.32%
ARROM(Lt) (Degree)	61.56	4.66	76.23	2.81	21.213	0.001***	14.52%
KI	21.19	2.04	13.64	1.57	23.248	0.001***	55.35%*
CVA (Degree)	37.7	2.91	46.96	2.96	17.223	0.001***	24.56%
NDI	36.2	2.51	23.8	2	56.407	0.001***	52.1%*

***Highly significant ($p \leq 0.001$) *Percentage Decrement

SD: standard deviation; p-value: probability value; Significant at level (p<0.05)

Rt. = Right; Lt. = Left; NDI= Neck Disability Index; AFROM= Active flexion range of motion; AEROM= Active extension range of motion; ALF= Active lateral flexion; ARROM= Active otation range of motion; KI=Kyphosis Index; CVA= Craniovertebral angle; NDI= Neck disability index

Table 5: Descriptive statistics of different post-treatment variables between Group A and Group B:

Variables	Group A		Group B		t-value	*p* -value
	Mean	SD	Mean	SD		
AFROM (Degree)	40.9	3.11	44.46	2.94	4.56	0.001***
AEROM (Degree)	49.4	2.59	54.9	3.5	6.905	0.002**
ALF(Rt) (Degree)	38.7	2.36	42.06	1.77	6.229	0.001***
ALF(Lt) (Degree)	38.7	2.32	42.46	1.67	7.205	0.001***
ARROM(Rt) (Degree)	70.8	3.06	77.16	2.45	8.882	0.001***
ARROM(Lt) (Degree)	67.66	3.85	76.23	2.81	9.835	0.002**
KI	18.19	2.07	13.64	1.57	9.542	0.001***
CVA (Degree)	42.16	2.5	46.96	2.96	6.772	0.001***
NDI	27.86	2.94	23.8	3.08	5.219	0.001***

***Highly significant ($p \leq 0.001$) **Significant ($p \leq 0.01$)

SD: standard deviation; p-value: probability value; Significant at level (p<0.05)

Rt. = Right; Lt. = Left; NDI= Neck Disability Index; AFROM= Active flexion range of motion; AEROM= Active extension range of motion; ALF= Active lateral flexion; ARROM= Active rotation range of motion; KI=Kyphosis Index; CVA= Craniovertebral angle; NDI= Neck disability index

Table 1 shows the Descriptive statistics of anthropometric variables (age, height, weight and BMI) in Group A and Group B. No significant difference was noted in any case.

Table 2 shows the descriptive statistics of different (Inter-group) pre-treatment variables of Group A and Group B. No statistically significant differences were noted.

Table 3 and Table 4 shows within-group (intra-group) analysis of Group A and Group B respectively, in which both interventions showed significant differences at post-treatment ($p<0.05$).

Table 5 shows inter-group analysis (Group A vs. Group B) with respect to variables at post-treatment measurement. Statistically significant differences (p<0.05) were noted.

DISCUSSION

This study compared the effects of Postural awareness and stretching and strengthening exercises in increasing cervical ROM in subjects with thoracic kyphosis and forward head posture and the results showed that there was significant (p<0.05) improvement in the same followed by both the procedures as well as significant (p<0.05) difference between the two procedures. The results of this study are in line with some previous studies. Quintero Y et al., 2009 stated in his study that 'Awareness through Movement' (ATM) is a process, which facilitates the learning of strategies for improving organization and coordination of body movement by developing spatial and kinaesthetic awareness of body-segment relationships at rest and during motion. Through the specific use of sensorimotor experiences, the Awareness through Movement (ATM) purports to enhance people's awareness of their habitual solutions to motor problems and the sensations accompanying those habits. Anticipatory postural adaptations enhance postural control and can be used in postural correction [14]. The strengthening of the back extensor muscles and the muscles around the spine has a significant effect on the reduction of kyphosis angle [15].

From the study we inferred that a treatment program involving both aspects that is, postural awareness and stretching and strengthening exercises would improve the forward head posture and thoracic kyphosis along-with improvement in the cervical range of motion. Exercise programs with elastic bands, which are easily accessible, can be used effectively in the correction of posture, without temporal and spatial limitations [16]. In our study, we used theraband for strengthening of the shoulder retractors that helped in improvement of forward head posture and thoracic kyphosis that further improved cervical range of motion. Liu S et al., 2016 stated in his study that for cervical ROM, the group had a significant increase (3.7°) in flexion, as compared to the C group at the end of the study. Two exercises targeted this movement, and our findings suggest that the combination of stretching (chin drop) and strengthening (chin tuck) effected this change.

Forward head posture is diagnosed when the Craniovertebral angle is less than 50° [16]. When comparing the craniovertebral angle measured before and after the treatment program, we found that it was increased by 12.03% in group A and 24.56% in group B. Kyphosis index in normal adults ranges from 3-13 [17]. In our study when we compared the kyphosis index measured before and after the treatment program, we found that the kyphosis index decreased by 17.75% in group A and 55.35% in group B.

Limitations of this study: A limited number of subjects in the study. The duration of intervention was four weeks only. There was no control group in the study.

CONCLUSION

The results of this study supported the previous studies which studied the effect of postural awareness and stretching and strengthening exercises in forward head posture and thoracic kyphosis and concluded that these exercises had great effects on cervical range of motion and neck disability. Ours is a positive finding with respect to the education and awareness component of postural programs and should inform all exercise programs that the postural awareness along with stretching and strengthening program should be engaged in any postural re-education program.

ABBREVIATIONS

FHP – Forward Head Posture
NDI – Neck Disability Index
BMI – Body Mass Index
CVA – Craniovertebral Angle
ATM – Awareness Through Movement

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Conflicts of interest: None

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