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The effect of Iyengar yoga exercises on upper crossed syndrome in college going students

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Abstract
Background: Upper cross syndrome (UCS) refers to the altered muscle activations and movement patterns in scapulae along with some abnormal alignment in the upper quarter, which may contribute to the dysfunction of the cervicothoracic and glenohumeral joints. It is one of the commonest postural disturbances which can cause neck pain; rounded shoulders, forward head posture. Iyengar yoga is a form of Hatha yoga with key aspects of correct alignment of the body and sequences of postures which focuses on improving muscle strength and flexibility.
Objective: To investigate the effectiveness of the Iyengar yoga exercises on the postural angles i.e., craniovertebral and shoulder angles in college going students with upper crossed syndrome.
Methodology: This randomised controlled trial, was conducted at the College of Physiotherapy, Miraj Medical Centre, Wanless Hospital, Miraj. 74 physical therapy students aged between 18 to 25 years affected with UCS, having a shoulder angle less than 52°, a craniovertebral angle less than 50° were purposefully recruited for this study, who were randomised into 2 equal groups. The experimental group performed Iyengar yoga exercises 3 times a week for 8 consecutive weeks and control group maintained normal daily activities. The craniovertebral and shoulder angles were measured the degree of forward head posture and rounded shoulder posture respectively from standing position by photogrammetry at baseline and after 8 weeks.
Results: The within group comparisons revealed significant changes in craniovertebral and shoulder angles of intervention group after 8 weeks. The between group comparisons indicated that 8-week Iyengar yoga exercise program significantly improved craniovertebral (p=0.001) and shoulder (p=0.001) angles.
Conclusion: The 8-week Iyengar yoga exercise program has successfully decreased the degrees of forward head and rounded shoulder. The present study demonstrates that the Iyengar yoga exercises for the individuals with UCS is feasible and effective method which optimises cervical and shoulder angles and thereby improving the spinal alignment and posture.

Keywords: upper crossed syndrome, forward head posture, rounded shoulder posture, college going students, Iyengar yoga

Introduction

Upper crossed syndrome (UCS) is a common postural dysfunctional pattern that describes the dysfunctional tone of the musculature of the shoulder girdle/cervicothoracic region of the body. This condition is given its name because an "X," in other words a cross, can be drawn across the upper body. One arm of the cross indicates the muscles that are typically tight/overly facilitated and the other arm of the cross indicates the muscles that are typically weak/overly inhibited [1].

Upper cross syndrome is a muscular imbalance discovered by Vladimir Janda, a Czech physician and physiatrist [2]. It's also referred to as proximal or shoulder crossed syndrome, cervical crossed syndrome, slouched posture, and student syndrome. Upper-Cross Syndrome (UCS) is also referred to as proximal or shoulder girdle crossed syndrome [3]. In UCS, tightness of the upper trapezius and levator scapula on the dorsal side crosses with tightness of the pectoralis major and minor. Weakness of the deep cervical flexors, ventrally, crosses with weakness of the middle and lower trapezius. This pattern of imbalance creates joint dysfunction, particularly at the atlanto-occipital joint, C4-C5 segment, cervicothoracic joint, glenohumeral joint, and T4-T5 segment [1, 2, 4].

It is one of the commonest postural disturbances which can cause neck pain; rounded shoulders, forward head posture and head ache may or may not be seen [3]. In UCS there is increase in volume of neck and shoulder pain, tension headaches, and chest tightness [3]. It is caused by chronic bad posture, and it is signified by rounded shoulders with an anteriorly tipped shoulder blade, forward poking chin and an apparent curve in the neck and upper back. As a result, tightness of the pectoral and neck muscles, arm flexor [3].

Prolonged periods where the head is positioned forward can cause the postural disorder termed "upper crossed syndrome." A person affected by this syndrome typically presents with a forward head posture, rounded shoulders, and scapular winging [5]. FHP is a forward inclination of the head with cervical spine hyperextension and is associated with shortening of the upper trapezius, the splenuis and semispinalis capitis and cervicis, the cervical erector spinae and the levator scapulae musculature [6]. RSP is a forward deviation of the shoulders associated with a protracted position of the scapula as caused by a muscular imbalance between a shortened pectoralis minor and a lengthened middle trapezius [6]. If cervical spine is held in protraction for long duration it can lead to poor head posture called forward head posture FHP. Failure of the head to align with the vertical axis of the body leads to more malalignments such as Rounded Shoulder Posture (RSP) [7]. The simultaneous occurrence of FHP and RSP is nothing but upper crossed syndrome [8].

Yoga is a way of living [9]. It was first introduced by Swami Vivekananda in the United States in 1893, and now yoga

practice has evolved to target health and beauty [9]. Iyengar yoga, currently the most prevalent style of yoga practiced by yoga journal subscribers (44%), is based on the teachings of the yoga master B.K.S. Iyengar [10]. In his 70 years of teaching, he has applied therapeutic variations of classical poses to many health problems [10]. Hatha or physical yoga is the most common branch of yoga practiced in the western world. Iyengar yoga is a style of hatha yoga, focused on improving muscle strength and flexibility, and includes standing postures that challenge balance [11]. It is an accessible form of yoga that can easily be modified to suit different ability levels with the use of props for support, such as straps, blocks, bolsters, pillows, and chairs [1].

Among all the forms of yoga, hatha yoga is the one that gives the most priority to the importance of physical fitness. Based on the interpretation of the word hatha – in Sanskrit the syllable "ha" means the sun, male energy, strength, and "tha" means the moon, female energy, flexibility - it can be summarized that hatha yoga is a dynamic balance between strength and flexibility, which concerns the physical, mental and also emotional level [12].

Hatha yoga (physical yoga exercise) includes specific exercises (yoga poses) called ''asanas.'' An adequately adopted asana is a stable pose with an optimal (correct), i.e., axial and symmetric, alignment of body parts in order to avoid overloading the passive elements of the locomotor system [13]. Concentrating on the correct alignment of body parts during yoga exercise leads to the shaping of proper posture. Studies focusing on the effects of yoga exercise on posture have suggested that it leads to improvements in posture [14, 15, 16]. Iyengar yoga places an emphasis on standing poses to develop strength, stability, stamina, concentration and body alignment. Props are utilized to facilitate learning and to adjust poses and instruction is given on how to use yoga to ease various ailments and stressors [17].

College going students generally assume variety of postures during their lectures and examinations [18]. Most of the students unconsciously adapt the forward flexed posture imposes stress on their body [18]. Recent studies have shown the prevalence of upper cross syndrome in medical as well as physiotherapy students. According to the data published in Lahore University, the prevalence of this syndrome among students was 37.1% [19].

A limited number of studies have focused on the use of yoga for musculoskeletal condition and only few numbers of studies have examined its effect among young people. Previous literature has demonstrated the promise of Iyengar yoga exercises for middle-aged women with upper crossed syndrome [18]. However, the utility of Iyengar yoga for the college going students is unknown

Objectives

- To investigate the effect of the Iyengar yoga exercises on the craniovertebral angle in college going students with upper crossed syndrome.
- To investigate the effect of the Iyengar yoga exercises on the shoulder angle in college going students with upper crossed syndrome.

Materials and methodology

- **Study design**

The current study was a parallel-group randomized, controlled trial comparing the 8-week Iyengar yoga exercise program to a control group without any intervention. An Ethical approval was taken by the ethical committee of the institution. The study was conducted at College of Physiotherapy, Miraj Medical Centre, Wanless Hospital, Miraj. The study protocol has been published elsewhere [23].

- **Participants**

74 participants both males and females', college going students aged between 18 to 25 years with BMI ≤ 29 were recruited in this study. All the participants completed and signed the informed consent form. The inclusion criteria were subjects having postural angles such as forward head (cervical angle $< 52^0$) and rounded shoulder (shoulder angle $<50^0$) as measured by kinovea software and photogrammetry, respectively [23]. Subjects having history of recent trauma, surgery, fractures to related joints such as vertebral fracture, scoliosis, torticollis, severe dysplasia, cervical spine instability, congenital shoulder deformities, any malignancy related to soft tissue and joints were excluded from the study.

- **Randomization**

Participants were randomly assigned to either the experimental or the control group. After randomization, pre-intervention measurements of Craniovertebral and Shoulder angles were obtained. And then, the treatment group performed the intervention for eight weeks, while the control group did not receive any intervention. All the measurements were taken after ending the intervention.

- **Intervention**

Iyengar yoga exercises are performed three times a week under the supervision of therapist. The participants in the experimental group performed general Iyengar yoga 1 day per week for 1 hour (Table 1) and Iyengar yoga exercises with an emphasis on spine and shoulder 2 days per week for half an hour each day (Table 2). Yoga exercises were done for 8-weeks. Participants in the control group did not perform Iyengar yoga exercises and they were asked to maintain their normal daily activities.

Table 1: General Iyengar Yoga Exercises (Once in a week)

Number	Movement Name	Description
1	Tadasana	Mountain pose
2	Utkatasana	Chair Pose
3	ArdhaUttanasana	Standing Half Forward Bend
4	Virabhadrasana I	Warrior Pose I
5	Virabhadrasana II	Warrior Pose II
6	Vrikshasana	Tree Pose
7	Utthitatrikonasana	Triangle Pose
8	Utthitaparśvakonasana	Extended Side Angle Pose
9	Parsvottanasana	Pyramid Pose

10	Darnikasana	Child pose
11	Adho-MukhaŚvanasana	Downward-facing dog poses
12	Urdhva-mukhaŚvanasana	Upward Facing Dog Pose
13	Parivrtta-trikonasana	Revolved Triangle Pose
14	ParivrttaParsvakonasana	Revolved Side Angle Pose
15	Salabhasana	Locust Pose
16	SalambaBhujangasana	Sphinx
17	Dhanurasana	Bow Posture
18	ArdhaurdhvaDhanurasana	Half Upper Bow Pose
19	Dandasana	Staff Pose
20	Gomukhasana	Cow Face Pose
21	Paschimottanasana	Seated Forward Bend
22	ParivrttaPaschimottanasana	Revolved Seated Forward Bend
23	BaddhaKonasana	Bound Angle Pose
24	UpavisthaKonasana	Wide-Angle Seated Forward Bend
25	Marichyasana	Sage's Pose
26	UrdhvaPrasaritaPadasana	Upward Extended Feet Pose
27	Anantasana	Sleeping Vishnu Pose
28	Setu Bandha Sarvangasana	Bridge Pose
29	Sarvangasana	Shoulder Stand
30	ViparitaKarani	Legs Up the Wall Pose

Table 2: Iyengar yoga exercises with an emphasis on spine and shoulder (Twice in a week)

Number	Movement Name	Description
1	Tadasana	Mountain pose
2	Bhujangasana	Cobra pose
3	Adho-MukhaŚvanasana	Downward-facing dog pose
4	Ustrasana	Camel pose
5	ArdhaUttanasana	Standing Half forward bend
6	Gomukhasana	Cow Face Pose
7	Vajrasana	Diamond Pose
8	ViparitaDandasana	Inverted Staff Pose
9	Salabhasana	Locust pose

- **Outcome variables**

Demographic characteristics such as age, weight, height, BMI were noted at baseline. Postural angles i.e., craniovertebral and shoulder angles were measured at the baseline (pre-test) and after 8 weeks (post-test). The intended postural angles were obtained by commercial camera (16.2MP) using optimal resolution without zooming [20].The camera lens was perpendicular to the floor and was placed on a tripod parallel to the participants. To capture the participants' natural alignment, subject was asked to bent forward 3 times and place hands on head 3 times, then look naturally and calmly to the imaginary point on the opposite wall [21]. Experimenter takes a photo after 5 seconds pause. Finally, the photos were transferred to the computer and processed using kinovea program [22]. After uploading the images in the software, 3 anatomical landmarks, including spinous process of C7, tragus, and acromion were identified. Thereafter the images were processed through Kinovea software using photogrammetric technique. Kinovea is a reliable tool that generates valid data and calculates the acceptable level of angular and linear measurements derived from the digitization of the x and y coordinates [22]. The craniovertebral and shoulder angles were measured as follow:

A. Craniovertebral Angle (CVA)

The cervical angle is a reliable angle to measure the FHP [24]. Skin marker were placed on the spinal process of C7 and in front of tragus of the ear. The angle between the horizontal line passing through the spinal process of C7 and the line that attach the central point of the tragus of the ear to the spinal process of C7 considered as the cervical angle [24]. If the cervical angle was less than 50°, the subject would be considered to have forward head posture [24]. (Figure 1)

B. Shoulder Angle (SA)

To assess shoulder posture, the angle between the horizontal line passing through the spinal process of the C7, and a line drawn from the midpoint of the shoulder joint to the spinal process of C7 was measured. skin markers were placed on the spinal process of C7 and on the midpoint of shoulder joint[25]. If the shoulder angle less than 52°, the subject would be considered to have forward shoulder posture [25]. (Figure 1)

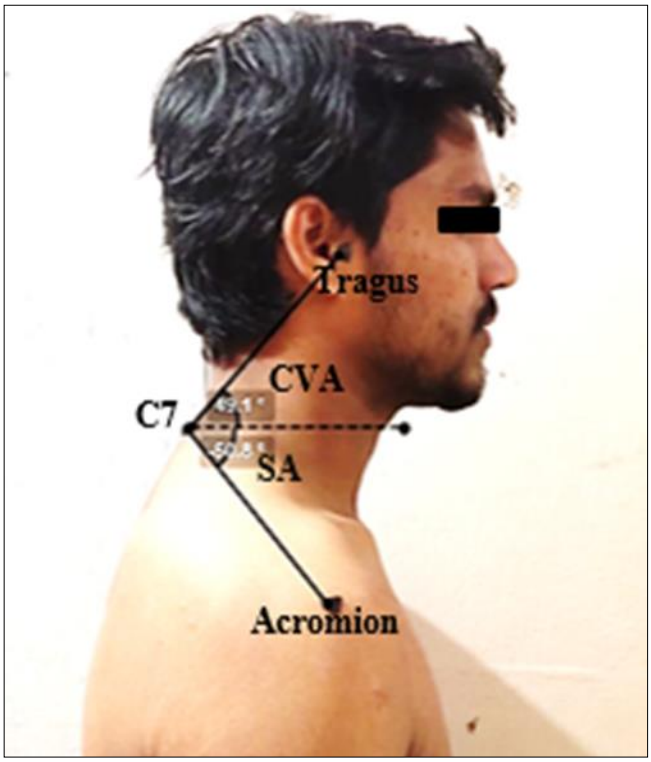


Fig 1: Postural angles in sagittal view- Craniovertebral Angle (CVA), Shoulder Angle (SA)

Results

74 college going students with UCS were included in this study considering the inclusion and exclusion criteria. 37 subjects in the intervention group performed Iyengar yoga exercises i.e. general Iyengar yoga exercises along with Iyengar yoga exercises with special emphasis on spine and shoulder (Table 1 and 2 respectively).

The study data were subjected to the Shapiro-Wilk test and all the variables were found to be normally distributed with a p-value of more than 0.05. Demographic description of the participants and normality distribution is shown in Table 3. Henceforth, we used the paired-sample t test to assess and compare the postural angle changes in participants before and after 8 weeks within both groups. Between group statistical analysis was done by independent t-test. Data were analysed using SPSS version 23. The level of statistical significance was set at $p < 0.05$

Within group comparisons indicates a significant-changes in the participants' craniovertebral (p=0.001) shoulder (p=0.001) angles of the experimental group after 8-weeks of the Iyengar yoga exercises were noticed when compared with those at baseline and with the control group (Table 5, Graph 2 and 3).

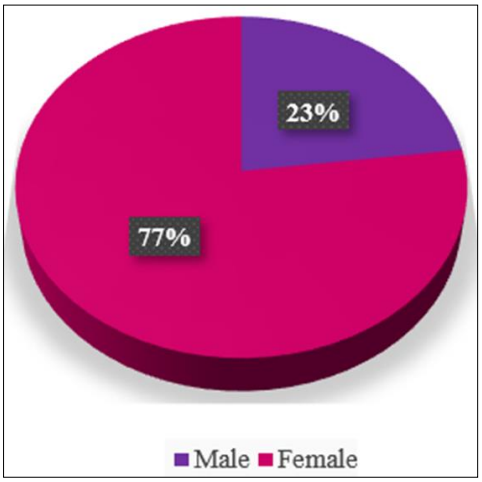
Between groups analysis for Craniovertebral and Shoulder Angles is significant for post-test and difference time frame at 5% level significance as the p-value is less than 5%. The between group comparisons indicated that 8-week Iyengar yoga exercise program significantly increased the Craniovertebral Angle (p=0.001) and Shoulder Angle (p=0.001) (Table 6).

Table 3: Baseline demographic characteristics in both study groups

Variables	Mean ± SD		t-value	p-value
	Experimental Group	Control Group		
Age	21.24± 1.09	20.783±1.22	1.072	0.093
Weight	60.02±13.40	57.10±11.68	0.999	0.321
Height	1.61±0.08	1.61±0.06	0.352	0.726
BMI	23.04±4.24	21.89±4.24	1.134	0.260

Table 4: Distribution of male and female in the study

Gender	Experimental Group	Control Group	Total
Male	10	7	17
Female	27	30	57
Total	37	37	74



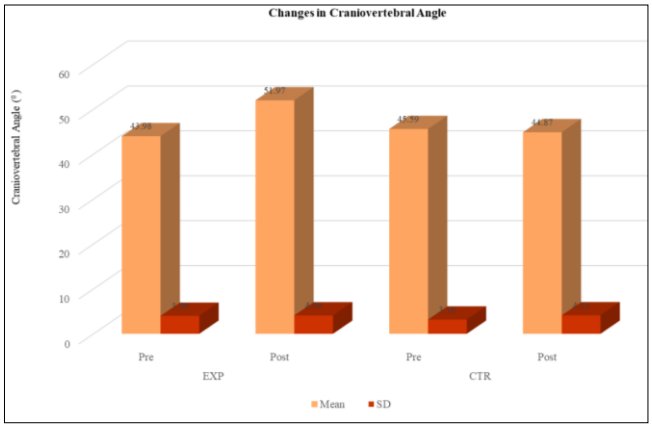
Graph 1: Percentage of males and females in the study

Table 5: Within group differences in postural angles

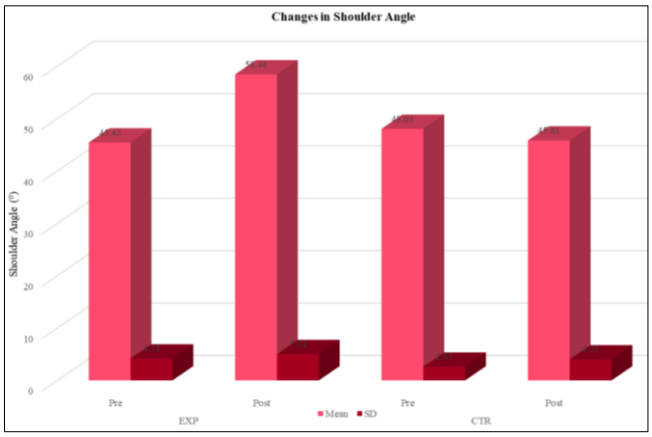
Group	Outcome variable	Mean ± SD		Effect size	t-value	p-value
		Pre-test	Post-test			
Experimental	CVA	43.98±3.99	51.97±4.09	3.06	18.609	0.001*
	SA	45.43±4.18	58.44.±5.02	6.12	37.200	0.001*
Control	CVA	45.59±3.16	44.87±4.11	0.46	2.795	0.008*
	SA	48.03±2.61	45.81±4.01	0.94	5.695	0.001*

Table 6: Between group comparison using independent t-test

Variable	Time	Mean ± SD		t-value	p-value
		Experimental	Control		
Craniovertebral Angle	Pre	43.98 ±3.99	45.59±3.16	1.935	0.057
	Post	51.97±4.09	44.87±4.11	7.447	0.001*
	Diff	7.99±2.61	0.72±1.58	17.378	0.001*
Shoulder Angle	Pre	45.43±4.18	48.03±2.16	3.204	0.002*
	Post	58.44±5.02	45.81±4.01	11.963	0.001*
	Diff	13.01±2.13	2.22±2.37	29.102	0.001*



Graph 2: Changes in Craniovertebral Angle from of pre-test to post-test



Graph 3: Changes in Shoulder Angle from of pre-test to post-test

Discussion

Current study was performed with the aim to investigate the effect of Iyengar yoga exercises on the Craniovertebral and Shoulder angle changes in college going students with UCS. The results of this study revealed that the implementation of 8 weeks of the Iyengar yoga spine and shoulder exercise program has substantially increased the craniovertebral and shoulder angles as compared with control group suggesting that the Iyengar yoga exercises had significant effect on Craniovertebral and Shoulder angles.

CVA measurement is an objective assessment of changes in the cervical angle [26, 27]. Previous studies found that subjects with head neck and shoulder discomfort are more likely to

have a smaller cervical angle [26, 27]. Small CVA imposes a greater load on the extensor muscles and surrounding connective tissues by increasing the external moment arm[28]. In the current study, the craniovertebral angle (CVA)was measured as an angle drawn between a line from the tragus of the ear to the last cervical vertebra and the horizontal line [29].

The results of current study showed that CVA was increased by 7 degrees after an 8-week Iyengar yoga exercise program that was in agreement with previous study [23]. Ghiasinezhad *et al*. (2016) found that eight weeks of yoga exercises significantly improved neck proprioception, motor control, and cervical posture of 15-17 years old girls [30]. In another study, Harman *et al*. (2005) found that 10 weeks of targeted and progressive home exercise program improved postural alignment related to FHP [31].

Few studies investigated the effects of training programs on the UCS. Shilan Sohrabi *et al* reported that CVA was increased in middle-aged women with upper crossed syndrome after 8-weeks of Iyengar yoga with an emphasis on spine and shoulder exercises[23]. Rajalaxmi *et al*. (2018) reported that yoga exercises significantly reduced forward head shift and shoulder protraction in people with UCS. In this study, the subjects received yoga Asanas, including Bhujangasana, Dhanurasana, Virabhadrasana, Eka Pada Bhekasana, Pranayama, Salabhasana, Adho Mukha Shvanasana, and Matsyendrasana. These asanas involve the lengthening of the spinal cord, and extension at the cervicothoracic joint and mobilization of the upper limb, and thoracic cage, and through these changes, they can improve posture [32].

In the current study, the forward shoulder angle (FSA) was determined by measuring the angle between the horizontal line passing through the spinal process of the C7, and the line attached the midpoint of the shoulder to the spinal process of C7 [18, 20]. With this way of angle calculation, the participants with rounded shoulder posture have a smaller angle [6, 23, 23]. The results showed that after 8 weeks of the Iyengar yoga exercises, the shoulder angle in students increased by 13 degrees, suggesting that the yoga exercises has trained the tissues that contribute to improved posture. This finding is consistent with previous studies [23]. Complex training has been shown to ameliorate postural deviations, namely, FHP and RSP [28]. Lynch *et al*. (2010) reported improvement in postural alignment in swimmers with round shoulder posture following an 8-week intervention[6]. Considering that rounded shoulder is a multifactorial deformity that may be affected by hypomobility of any segment of the spine, rib articulation, or joint of the shoulder girdle, including the acromioclavicular, sternoclavicular, and shoulder joints, as well as shortness of the muscles related to any segment of the spine, ribcage, and shoulder girdle [34], Iyengar yoga with an emphasis on spine and shoulder exercises could improve posture by addressing hypomobility and shortness [23].

Iyengar yoga exercises bestows appropriate flexibility of tonic muscles that maintain posture and adequately strengthened phasic muscles which are responsible for the movement of the distal segments of the body. Therefore, Iyengar yoga proved an effective form of exercise from the viewpoint of the postural muscles. Iyengar yoga exercises includes the asanas which elongates the spine, reduces flattening of the antero-posterior spinal curvature, expands the chest, encourages proper head posture, prevents an unnatural retraction of the shoulder blades. Grabara had mentioned that poses (asanas) such as, Mountain pose, Extended Triangle Pose or Extended Side Angle Pose elongates the spine in the vertical [35].

Sohrabi S *et al* concluded that the reason behind the effectiveness of the Iyengar yoga program is that the Iyengar yoga exercises with specially concentrating on spine and shoulder are focused on balancing FHP-related major muscle groups, including stretching of the cervical extensors and pectoral muscles and strengthening of the deep cervical flexors, and shoulder retractors [23]. Another possible explanation for the effect of the Iyengar yoga program on forward head posture is that yoga could improve proprioception and motor control, hence cervical spine posture [30].

Yoga makes the body more flexible, strengthens muscles and, above all, is conducive to spinal elongation and in maintaining correct body posture. Yoga practitioners consciously work with their bodies to properly align their body, so that that the obtained yoga position becomes ever more stable and comfortable [36]. The most important aspects of practicing yoga is postural re-education, i.e. the development and maintenance of correct body posture, which is often hindered by a number of improper postural habits [36].

Śleboda confirmed the therapeutic and educational value of relaxation and concentration exercises with integrated elements of hatha yoga as well as general kinesiology education, aimed at improving the body posture and agility of 8-year-old boys and girls [37]. The beneficial effects of yoga on body posture were also noted in a study of fifteen 10-year-old children. After 6 months of practicing yoga, a significant correction was observed in shoulder and hip asymmetry, a reduction of head protrusion as well as the disappearance of such symptoms such as contracture of the pectoral muscles and back extensors [38]. Increment in strength and flexibility and enhanced awareness of posture may be the mechanisms by which postural improvements occurred [39]. All of these aforementioned research results endorse the positive effects of hatha yoga o body posture, regardless of a subject's age and gender.

Performing each asana requires concentration and control of the body's position in order to avoid breaking the proper movements when entering a pose [40]. Isometric contractions of the muscles enhance proprioceptive stimulation of the parts of the body that are involved, which in turn has a positive influence on their functioning. Stimulating such receptor can improve the functioning of the whole system, for example, through biofeedback [40]. Furthermore, performing asanas can also release muscle tension, strengthen the ligamentous-capsular system and synovial tendon sheaths, as well as remove fascial restrictions [40]. Thus, hatha yoga can be effectively used not only as a corrective exercise, but in kinesiotherapy and as a form of preventive treatment [41].

With regards to physiotherapeutic processes, yoga as a set of "static-dynamic procedures" can be considered as a "self-mobilization" of the nervous system and the joints, spine and limbs [41]. Yoga exercises can influence the musculoskeletal and nervous systems via mobilization or auto-mobilization of both joints and nerves respectively for example, one of McKenzie's static procedures and the "Cobra" asana are almost the equivalent and can directly lead to alleviation of pain symptoms of low back and cervical pain [42, 43].

Conclusion

The results of the present study demonstrated that the implementation of eight weeks of the Iyengar yoga exercises for the college going students with UCS is feasible had a significant effect on the craniovertebral and shoulder angles in students with UCS. And so, the study confirms that the practice of Iyengar yoga could improve postural abnormalities associated with UCS in college going students. Iyengar yoga exercises which include stretching, strengthening, integrating of the spine and shoulder that can regularly be performed, can have a beneficial effect in reducing the forward head and rounded shoulder posture related to UCS.

Limitations

- The existing study did not investigate the durability of postural changes brought by Iyengar yoga exercises and it remains to be determined how long the effects would continue.

Suggestions

- Same study can be done using larger sample.
- Same study can be done in different population.
- Same study can be done for longer period.
- Future study can be done to find out detraining effect after following 8-week Iyengar yoga exercises.
- Further research can be done to examine the effect of Iyengar yoga exercises on kyphotic angle in college going students.

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References

1. Muscolino J. AustTradit Med Soc "Upper Crossed Syndrome",2015:21:80-5.
2. Page P, Frank CC, Lardner R. Assessment and treatment of muscle imbalance: the Janda approach. Human kinetics, 2010.
3. Sandiya R, Kiruthika S. *et al*. "The Effect of Shoulder Girdle Exercises on Upper Cross Syndrome Among Students" International Journal of Creative Research Thoughts, 2018.
4. Mogharrabi-Manzari M, Ghasemi G, Negahban H. The effect of eight-week shoulder girdle, pelvic girdle and combined corrective exercises on maximal voluntary ventilation in female students with upper crossed syndrome: a randomized clinical trial. Journal of Rehabilitation Sciences & Research,2021:8(2):51-6.
5. Ranđelović I, Jorgić B, Antić V, Hadžović M. Effects of exercise programs on upper crossed syndrome: A systematic review. Fizičkovaspitanjei sport krozvekove,2020:7(2):152-68.
6. Lynch SS, Thigpen CA, Mihalik JP, Prentice WE, Padua D. The effects of an exercise intervention on forward head and rounded shoulder postures in elite swimmers. British journal of sports medicine,2010:44(5):376-81.
7. Singla D, Veqar Z. Association between forward head, rounded shoulders, and increased thoracic kyphosis: a review of the literature. Journal of chiropractic medicine,2017:16(3):220-9.
8. Buckle PW, Devereux JJ. The nature of work-related neck and upper limb musculoskeletal disorders. Applied ergonomics,2002:33(3):207-17.
9. Sengupta P. Health impacts of yoga and pranayama: A state-of-the-art review. International journal of preventive medicine,2012:3(7):444.
10. Williams KA, Petronis J, Smith D, Goodrich D, Wu J, Ravi N, Doyle Jr EJ, *et al*. Effect of Iyengar yoga therapy for chronic low back pain. Pain,2005:115(1-2):107-17.
11. Tiedemann A, O'Rourke S, Sesto R, Sherrington C. A 12-week Iyengar yoga program improved balance and mobility in older community-dwelling people: a pilot randomized controlled trial. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences,2013:68(9):1068-75.
12. Petric M, Vauhnik R, Jakovljevic M. The impact of hatha yoga practice on flexibility: A pilot study. Altern Integr Med,2014:3160:2-10.
13. Grabara M. Spinal curvatures of yoga practitioners compared to control participants—a cross-sectional study. PeerJ,2021:9:e12185.
14. Grabara M, Szopa J. Effects of hatha yoga on the shaping of the antero-posterior curvature of the spine. Human Movement,2011a:12(3):259–263. DOI 10.2478/v10038-011-0028-4.
15. Grabara M, Szopa J. Habitual body posture and Mountain position of people practising yoga. Biology of Sport,2011b:28(1):51-54 DOI 10.5604/935872.
16. Grabara M. Effects of 8-months yoga training on shaping the spine in people over 55. Biomedical Human Kinetics,2014b:5(1):59-64 DOI 10.2478/bhk-2013-0009.
17. Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. International journal of yoga,2011:4(2):49.
18. Pratik Chandarana, Sheshna Rathod, Dinesh Sorani "Prevalence of Upper Crossed Syndrome in College Going Students - An Observational Study" International Journal of Health Sciences and Research, 2022,1(3).
19. Mubeen I, Malik S, Akhtar W, Iqbal M, Asif M, Arshad A, Zia S, *et al*. "Prevalence of Upper Cross Syndrome among the Medical Students of University of Lahore." International Journal of Physiotherapy,2016:3(3):381-384.DOI - 10.15621/ijphy/2016/v3i3/100851
20. Porto AB, Okazaki VHA. Procedures of assessment on the quantification of thoracic kyphosis and lumbar lordosis by radiography and photogrammetry: A literature review. Journal of Bodywork and Movement Therapies,2017:21(4):986-94. [DOI:10.1016/j.jbmt.2017.01.008] [PMID]
21. Hajihosseini E, Norasteh A, Shamsi A, Daneshmandi H. The effects of strengthening, stretching and comprehensive exercises on forward shoulder posture correction. Physical Treatments-Specific Physical Therapy Journal,2014:4(3):123-32.
22. Puig-Diví A, Padullés-Riu JM, Busquets-Faciaben A, Padullés-Chando X, Escalona-Marfil C, Marcos-Ruiz D. Validity and reliability of the kinovea program in obtaining angular and distance dimensions. Preprints,

2017. 2017100042. [DOI:10.20944/preprints201710.0042.v1]
23. Sohrabi S, Rahimi M, Babaei-Mobarakeh M, Piri H. The effect of eight weeks of Iyengar yoga with an emphasis on spine and shoulder exercises on the upper cross syndrome in middle-aged women. Journal of Modern Rehabilitation, 2020.
24. Ruivo RM, Pezarat-Correia P, Carita AI. Cervical and shoulder postural assessment of adolescents between 15 and 17 years old and association with upper quadrant pain. Brazilian journal of physical therapy,2014:18:18:364-71.
25. Lewis JS, Wright C, Green A. Subacromial impingement syndrome: the effect of changing posture on shoulder range of movement. Journal of Orthopaedic & Sports Physical Therapy,2005:35(2):72-87.
26. Lee NK, Jung SI, Effects of exercise on cervical angle and respiratory function in smartphone users. Osong Public Health and Research Perspectives,2017:8(4):271.
27. Yip CH, Chiu TT, Poon AT. The relationship between head posture and severity and disability of patients with neck pain. Manual therapy,2008:13(2):148-54.
28. Kim DH, Kim CJ, Son SM. Neck pain in adults with forward head posture: effects of craniovertebral angle and cervical range of motion. Osong public health and research perspectives,2018:9(6):309.
29. Selvaganapathy K, Rajappan R, Dee TH. The effect of smartphone addiction on craniovertebral angle and depression status among university students. International Journal of Intagrative Medical Sciences,2017:4(5):537-42.
30. Ghiasinezhad S, Hadadnezhad M, Letafatkar A. The effects of eight weeks of yoga training on motor control, proprioception and forward head angle among girls diagnosed with forward head posture. International Journal of Medical Research & Health Sciences,2016:5(11):40-6.
31. Harman K, Hubley-Kozey CL, Butler H. Effectiveness of an exercise program to improve forward head posture in normal adults: a randomized, controlled 10-week trial. Journal of Manual & Manipulative Therapy,2005:13(3):163-76.
32. Rajalaxmi V, Paul J, Nithya M, Lekha SC, Likitha B. Effectiveness of three-dimensional approach of schroth method and yoga on pulmonary function test and posture in upper crossed syndrome with neck Pain-A double blinded study. Research Journal of Pharmacy and Technology,2018:11(5):1835-9.
33. Park HC, Kim YS, Seok SH, Lee SK. The effect of complex training on the children with all of the deformities including forward head, rounded shoulder posture, and lumbar lordosis. J ExercRehabil,2014:10(3):172-5. doi: 10.12965/jer.140113. PMID: 25061597; PMCID: PMC4106772.
34. Wong CK, Coleman D, diPersia V, Song J, Wright D. The effects of manual treatment on rounded-shoulder posture, and associated muscle strength. J Bodyw Mov Ther,2010:14(4):326-33. doi: 10.1016/j.jbmt.2009.05.001. Epub 2009 Jun 26. PMID: 20850039.
35. Grabara M, Szopa J. Effects of hatha yoga exercises on spine flexibility in women over 50 years old. Journal of physical therapy science, 2015, 27(2).
36. Grabara M, Szopa J. Effects of hatha yoga on the shaping of the antero-posterior curvature of the spine. Human Movement,2011:3(12):259-63.
37. Śleboda R. Effects of an integrated program of yoga and educational kinesiology on the musculoskeletal con-dition in children aged 8 years AWF, Kra-ków, 2002
38. Savić K, Pfau D, Skorić S, Pfau J, Spasojević N. The effect of Hatha yoga on poor posture in children and the psychophysiologic condition in adults. MedicinskiPregled,1990:43(5-6):268-272.
39. Greendale GA, Mc Divit A, Carpenter A, Seeger L, Huang M-H. Yoga for women with hyperkyphosis: Results of a pilot study. American Journal of Public Health,2002:92(10):1611-4. [DOI:10.2105/AJPH.92.10.1611] [PMID] [PMCID]
40. Posadzki P. Selected aspects of yoga in view of manual therapy [in Polish]. Medycyna Manualna,2005:1-2:9-20.
41. Paul Posadzki, Sheetal Parekh. “Yoga and Physiotherapy: A Speculative Review and Conceptual Synthesis”, 2009 Chinese Journal of Integrative Medicine
42. Posadzki P. Yoga in aspect of manual therapy. J Man Med,2005:9:9-20.
43. Posadzki P. Yoga in aspect of neuromobilisations. J Man Med,2006:10:15-26.