

Research Paper: 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



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ABSTRACT

Introduction: Upper Crossed Syndrome (UCS) is a combination of forward head, rounded shoulder, and hyperkyphosis deformities. Yoga is a non-competitive physical exercise with the potential to correct postural imbalances in the human body. Iyengar yoga is a form of Hatha yoga.

Materials and Methods: The purpose of present study was to evaluate the effect of Iyengar yoga with an emphasis on spine and shoulder exercises on the UCS in middle-aged women. In this quasi-experimental applied research, 15 subjects were purposefully recruited out of middle-aged women affected with UCS. The participants performed Iyengar yoga exercises with an emphasis on the spine and shoulder. The photogrammetry method was used to measure UCS.

Results: At the end of 8 weeks exercises, there was a significant increase in the cervical ($P < 0.001$) and shoulder angles ($P < 0.005$), and a significant decrease in thoracic flexion angle ($P < 0.001$).

Conclusion: All relevant coaches and therapists are recommended considering Iyengar yoga as an alternative for training programs in middle-aged women affected by UCS.

1. Introduction

To evaluate the effect of Iyengar yoga with an emphasis on spine and shoulder exercises on the UCS in middle-aged women. Posture is defined as the appropriate arrangement of the body parts [1]. In a balanced structure, local and global muscles activate accordingly to protect the body and spine from injuries during activities such as lifting, sitting, and standing [2]. However, a faulty relationship

between various parts of the body with abnormal spinal curves may impair this balance [3]. In this regard, Vladimir Janda recognized three muscle imbalance patterns that accompany with distinctive pain syndromes: the upper crossed, pelvic crossed, and stratification syndromes [4]. Upper Crossed Syndrome (UCS) is also referred to as forward head and rounded shoulder posture, forward head posture and protracted shoulders, and proximal or shoulder girdle crossed syndrome [4-6]. UCS has been defined as tightness or facilitation of postural muscles,

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namely, the pectoralis major, pectoralis minor, subscapularis, latissimus dorsi, levator scapulae, upper trapezius, teres major, sternocleidomastoid, upper trapezius, and scalenes, and weakness or inhibition of phasic muscles, namely, the rhomboids, serratus anterior, middle and lower trapezius, teres minor, infraspinatus, and the deep neck flexors [7, 8]. Janda called this syndrome “upper crossed” because when the weakened and tightened muscles are joined in the upper body, they form a cross [9].

UCS results from muscle imbalances between two types of muscles, namely, postural or tonic and phasic muscles [10]. Predominantly postural or tonic muscles such as pectoralis major tend to become tight, whereas predominantly phasic muscles such as deep-neck flexors tend to become weak [11]. People who afflicted with UCS will show particular postural changes, including Forward Head Posture (FHP), rounded back, elevation and protraction of the shoulders, winging of the scapula, and diminished mobility of the thoracic spine [4, 8].

FHP and Rounded Shoulder Posture (RSP) as the components of UCS are prevalent in people of all ages and with different jobs [6, 12-15]. In an Iranian academic dental staff, the prevalence rates of the FHP and RSP have been reported as 85.5%, 68.8%, respectively [14]. The prevalence of UCS in laundry workers is reported as 28% [11].

Many disorders are linked with UCS, including migraine headaches; chronic headaches; Subacromial impingement; biceps tendinitis; thoracic outlet syndrome; degeneration of the cervical spine; and joint dysfunction at the C1-C2 segment, C4-C5 segment, cervicothoracic joint, and T4-T5 segment [1, 4, 8, 9, 16]. Also, dysfunction in the sternoclavicular joint, acromioclavicular joint and thoracic and cervical facet joints have been proposed as potential joint dysfunctions in individuals with UCS [8]. Altered scapular kinematics and muscle activity, modification in biomechanics and neuromuscular control of the shoulder complex and upper extremity, and reduction in glenohumeral stability are among the other consequences of UCS [1, 4, 5, 17]. UCS-related disorders greatly affect the safety and health status worldwide and it may increase in the near future [18].

Yoga is a way of living. It was first introduced by Swami Vivekananda in the United States in 1893, and now yoga practice has evolved to target health and beauty [19]. Yoga has been traditionally used to treat many pains or malpostures like hyperkyphosis in various populations [20]. Iyengar yoga is a form of Hatha yoga with key aspects of correct alignment of the body and sequences of postures using props such as blocks, belts (rope), and

chairs [21]. To the best of our knowledge, the effect of Iyengar yoga with an emphasis on spine and shoulder exercises on UCS has not been studied. Previous studies have examined the effects of general yoga exercises on hamstring flexibility, and discrete abnormalities such as hyperkyphosis [22-27]. Also, the effects of different exercises such as scapular stabilization, strengthening and stretching, and comprehensive exercises on the discrete component of UCS such as FHP, RSP, and kyphosis have been investigated [28-30].

Considering the high prevalence of UCS and its frequent complications, there is no evidence about the effectiveness of Iyengar yoga with an emphasis on spine and shoulder exercises for the management of UCS. So, regarding the safety of yoga exercises and the possibility of doing these exercises by a person alone at home, this study aimed to evaluate the effect of Iyengar yoga with an emphasis on spine and shoulder exercises on correcting UCS in middle-aged women.

2. Materials and Methods

In this quasi-experimental applied study, 15 participants were selected, using a convenience sampling method from middle-aged women afflicted with UCS, aged between 45 and 61 years. Considering $\alpha=0.05$, the power of 80%, and an effect size of 0.80, the sample size was determined as 15 subjects by using G*Power software [31]. The inclusion criteria for the participants were having a shoulder angle less than 52°, a cervical angle less than 50°, and a thoracic flexion angle of more than 50° [32, 33]. The participants would be excluded if they had a vertebral fracture, scoliosis, severe dysplasia, rheumatic disease, torticollis, persistent respiratory problems, uncontrolled hypertension, pulmonary disease, cervical spine, and shoulder instability. They would also be excluded if they missed practice for two consecutive sessions or more. All participants were informed about the procedures and signed a consent form before the initiation of the study.

Yoga exercises are performed three times a week. The participants performed general Iyengar yoga 1 day per week (1 hour each day) (Table 1) and Iyengar yoga home-based training with an emphasis on spine and shoulder exercises 2 days (half an hour each day) per week (Table 2). They were monitored through phone calls, and an exercise checklist was completed by each participant. All exercise sessions began with the mountain posture (Tadasana), followed by positions focused primarily on elongating the spine and improving flexibility, balance, muscle strength, and endurance [22]. Yoga exercises were done for 8 weeks.

Table 1. General Iyengar yoga exercises

Number	Movement Name	Description
1	Tadasana	Mountain pose
2	Utkatasana	Chair Pose
3	Ardha Uttanasana	Standing Half Forward Bend
4	Virabhadrasana I	Warrior Pose I
5	Virabhadrasana II	Warrior Pose II
6	Vrikshasana	Tree Pose
7	Utthita trikonasana	Triangle Pose
8	Utthita parśvakonasana	Extended Side Angle Pose
9	Parsvottanasana	Pyramid Pose
10	Darnikasana	Child pose
11	Adho-Mukha Śvanasana	Downward-facing dog pose
12	Urdhva-mukha Śvanasana	Upward Facing Dog Pose
13	Parivrtta-trikonasana	Revolved Triangle Pose
14	Parivrtta Parsvakonasana	Revolved Side Angle Pose
15	Salabhasana	Locust Pose
16	Salamba bhujangasana	Sphinx
17	Dhanurasana	Bow Posture
18	Ardha urdhva Dhanurasana	Half Upper Bow Pose
19	Dandasana	Staff Pose
20	Gomukhasana	Cow Face Pose
21	Paschimottanasana	Seated Forward Bend
22	Parivrtta Paschimottanasana	Revolved Seated Forward Bend
23	Baddha Konasana	Bound Angle Pose
24	Upavistha Konasana	Wide-Angle Seated Forward Bend
25	Marichyasana	Sage's Pose
26	Urdhva Prasarita Padasana	Upward Extended Feet Pose
27	Anantasana	Sleeping Vishnu Pose
28	Setu Bandha Sarvangasana	Bridge Pose
29	Sarvangasana	Shoulder Stand
30	Viparita Karani	Legs Up the Wall Pose

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The intended angles of the body were obtained by commercial cameras (16.2-MP Samsung Digital Camera, WB30F, made in South Korea) using optimal resolution without zooming [34]. The camera lens was perpendicular to the floor and was placed on a tripod parallel to the participants. The camera was set at 50% of the participant's height from the ground. To normalize the angle of the camera lens and increase the measurement accuracy, each participant's height was used to calibrate the images. The body of the participant was aligned with the plumb line [34]. The privacy and comfort of the participants were guaranteed [35].

To capture the participant's natural alignment, each person 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 [28]. Then the experimenter takes a photo after 5 seconds pause [28]. Finally, the photos were transferred to the computer and processed using the Kinovea program [36]. This program has been used in previous studies, and it is both valid and reliable [36]. The following measurements were used to assess UCS.

Table 2. The Iyengar yoga home-based exercises with emphasis on spine and shoulder

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

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Cervical angle

The cervical angle is a reliable angle to measure the FHP [32]. 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 [32] (Figure 1). A skin marker was placed on the spinal process of C7. If the cervical angle was less than 50°, the subject would be considered to have FHP [32].

Shoulder angle

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 [37] (Figure 1). A skin marker was placed on the spinal process of C7. If the shoulder angle less than 52°, the subject would be considered to have forward shoulder posture [32].

Thoracic flexion angle

The thoracic kyphosis was determined by measuring the thoracic flexion angle [38]. Skin markers were placed on the spinous process of the seventh cervical vertebra (C7) and the 12th thoracic vertebra (T12). The point where perpendicular lines to the skin surface through T12 and C7 markers cross each other shapes the thoracic flexion angle [38] (Figure 2). If the thoracic flexion angle was more than 50°, the subject would be considered to have a hyperkyphosis posture [33].

After uploading the images in the software, using a high precision pen with the ability to sense 1024 pressure levels, anatomical points, including C7, T12, ear tragus, and the midpoint of the shoulder joint were identified. Then, with the Kinovea software and photogrammetric technique, the images were processed. The cervical, shoulder, and thoracic flexion angles were measured individually. Kinovea is a reliable tool that generates valid data

**Figure 1.** Cervical angle (CA) and Shoulder Angle (SA)

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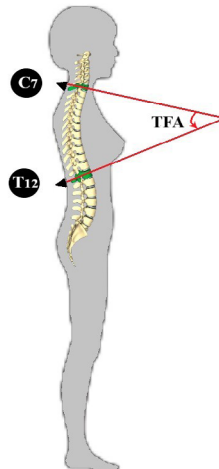


Figure 2. Thoracic Flexion Angle (TFA)

and calculates the acceptable level of angular and linear measurements derived from the digitization of the x and y coordinates [36]. Measurements were carried out before the first yoga class (pre-test) and after the last yoga class (post-test). Data were analyzed using IBM SPSS version 20. Descriptive statistics were calculated for all variables. The Shapiro-Wilk test was used to test normality given the small sample size. The paired-sample t test was used to compare the within-group differences. The level of statistical significance was set at $P < 0.05$.

3. Results

In this study, 20 middle-aged women with UCS were screened and five participants dropped out of the study considering the inclusion and exclusion criteria. Thus, 15 subjects performed Iyengar yoga home-based training with an emphasis on spine and shoulder exercises (Table 3).

Table 3. Demographic characteristics of the participants

Variables	Intervention Group (n=15)
	Mean±SD
Age (y)	53.1±6.47
Height (cm)	159.2±6.84
Weight (kg)	66.3±8.46
BMI (kg/m^2)	26.2±3.39

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. Hence we used the paired-sample t test to assess the postural changes in participants before and after 8 weeks.

In participants' posture, a significant change in the cervical ($P < 0.001$), shoulder ($P < 0.005$) and thoracic flexion ($P < 0.001$) angles after 8 weeks of the Iyengar yoga with an emphasis on spine and shoulder exercises were noted when compared with those at baseline (Table 4).

4. Discussion

This study aimed to investigate the effect of the Iyengar yoga with an emphasis on spine and shoulder exercises on the cervical, shoulder, and thoracic flexion angles changes in middle-aged women with UCS. To the best of our knowledge, the present study is the first study that investigated the effect of Iyengar yoga with an empha-

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Table 4. Pre-test comparison of variables

Variables	Mean±SD		t	P
	Pre-test	Post-test		
Cervical angle	38.4±10.1	49.53±7.45	-7.48	0.001*
Shoulder angle	29.4±4.37	44.54±3.51	-17.57	0.001*
Thoracic flexion angle	66±6.54	46.51±5.33	32.85	0.001*

* Significant (The significance level is considered to be $P < 0.05$).

sis on spine and shoulder exercises on UCS. The results of the current study showed that the implementation of eight weeks of the Iyengar yoga spine and shoulder training program had a significant effect on the cervical, shoulder, and thoracic flexion angles in middle-aged women with UCS. Few studies investigated the effects of training programs on the UCS. 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 [39].

In the present study, which was performed on middle-aged women suffering from hyperkyphosis with a mean angle of 66 degrees, 8 weeks of the Iyengar yoga with an emphasis on spine and shoulder exercises, decreased the kyphosis angle by 12 degrees. The current study result is consistent with previous studies results [23-27]. Greendale et al. (2009) proved a substantial decrease in the kyphosis angle in people participating in yoga classes for 24 weeks, compared to people not participating in these classes [23]. The improvement in spinal posture as the result of yoga is also confirmed by the investigation of children's and adults' posture [24, 25, 27]. Increment in strength and flexibility and enhanced awareness of posture may be the mechanisms by which postural improvements occurred [26]. Another explanation for the decrease in kyphosis angle is that most yoga asanas are performed on the elongated spine. Elongation of the spine could reduce pelvic anteversion and lumbar lordosis, and because of the chain reaction in spinal curvatures, the kyphosis angle of the thoracic area will reduce [24].

In the current study, the forward head angle was measured as an angle drawn between a line from the tragus of

the ear to the last cervical vertebra and the horizontal line [40]. In this method of measurement, the participants with forward head posture have a smaller angle relative to people with normal head posture. Based on the results of the present study, the cervical angle increased by 11 degrees after eight weeks of the Iyengar yoga with an emphasis on the spine and shoulder. This finding agrees with previous investigations [41, 42]. 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 [41].

In another study, Harman et al. (2005) found that 10 weeks of targeted and progressive home exercise program improved postural alignment related to FHP [42]. A probable reason for the effectiveness of the Iyengar yoga program is that the Iyengar yoga with an emphasis on spine and shoulder exercises program 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. Another 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 [41].

In the current study, the shoulder angle 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. With this way of angle calculation, the participants with rounded shoulder posture have a smaller angle. The results showed that after 8 weeks of the Iyengar yoga with an emphasis on spine and shoulder exercises, the angle of the shoulder in women increased by 15 degrees, suggesting that the movements trained the tissues that contribute to improved posture. This finding is consistent with previous studies [43, 44]. Complex training has been shown to ameliorate postural deviations, namely, FHP and RSP [44].

Lynch et al. (2010) reported improvement in postural alignment in swimmers with round shoulder posture following an 8-week intervention [43]. 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 [45], Iyengar yoga with an emphasis on spine and shoulder exercises could improve posture by addressing hypomobility and shortness.

This study has several limitations. A control group was not included in the current study. The sample size was small and this work should be done with a larger sample size. The yoga exercises are designed to be performed both at home and under supervision of coach at the gym, and greater changes could likely occur if they were performed under the full supervision of a coach and or corrective exercise specialist. The present study did not investigate the durability of postural changes and it remains to be determined how long the effects would continue.

5. Conclusion

The results of the present study showed that the implementation of eight weeks of the Iyengar yoga with an emphasis on spine and shoulder exercises had a significant effect on the cervical, shoulder, and thoracic flexion angles in middle-aged women with UCS. Generally, maintaining an active and healthy lifestyle through yoga exercise can be a key element in correcting the UCS in these women. The Iyengar yoga is a style of Hatha yoga with key aspects of correct alignment of the body and sequencing of the postures. It seems that Iyengar yoga with an emphasis on spine and shoulder exercises can correct UCS. It is a safe and cheap intervention to use in the prevention and rehabilitation area, too.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages; they were also assured about the confidentiality of their information. Moreover, they were allowed to leave the study whenever they wish, and if desired, the results of the research would be available to them.

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Authors contributions

All authors contributed in preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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