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Original Article

The Effect of 8 Weeks of Selected Corrective Exercises on Upper Cross Syndrome in Carpet Weaver Women

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Abstract

Introduction: Upper Cross Syndrome (UCS) is a musculoskeletal disorder characterized by muscle imbalance, specifically involving shortening and weakness of certain muscles. This study aimed to determine the effect of eight weeks of selected corrective exercises on UCS in Carpet weaver women.

Methods: In this quasi-experimental study, 30 women with kyphosis, exhibiting forward head posture, forward shoulder posture, and hyperkyphosis, participated. The participants were randomly assigned to two groups of 15, experimental and control. The experimental group performed selected corrective exercises for eight weeks, three days a week. Forward head angle was measured using a goniometer, forward shoulder angle using a double square, and kyphosis angle using a flexible ruler before and after the intervention. The data were analyzed using repeated measures ANOVA in SPSS software package ($P \leq 0.05$).

Results: In the experimental group, a significant reduction in forward head angle ($p=0.01$) and kyphosis angle ($p=0.008$) was observed after eight weeks of exercise. However, there was no significant difference in forward shoulder posture ($p=0.06$).

Conclusion: Considering the significant reduction in forward head and kyphosis angles in the experimental group, the use of this exercise program is recommended for individuals with forward head posture and kyphosis abnormalities.

Keywords: Corrective exercises, Upper Cross Syndrome, Forward shoulder, Kyphosis, Female carpet weavers

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Introduction

Carpet weaving, as one of the most important handicraft industries of humanity, symbolizes the civilization and dynamism of human thought and has been prevalent in Iran since ancient times. The position of Iranian carpets among other nations has been exceptional(1). Carpet weaving is one of the traditional occupations in countries like Iran, Turkey, Russia, and several other nations. In Iran, nearly two and a half million people are engaged in carpet weaving as full-time workers, and half a million people work part-time(2). The improper postures resulting from poor carpet design, long working hours, inadequate rest periods, inappropriate ergonomic conditions, repetitive movements, physical stress, inefficient tools and equipment, lack of work diversity, and inappropriate work schedules are characteristics of the carpet weaving profession and contribute to musculoskeletal disorders in carpet weavers. Prolonged and continuous work by carpet weavers leads to musculoskeletal disorders, including common abnormalities among weavers in our country. Studies indicate that musculoskeletal disorders among carpet weavers are more prevalent in the shoulder and lower back region compared to other parts of their bodies(3-5).

Muscle imbalance can disrupt the natural alignment of the body and predispose it to various postural abnormalities, sometimes making individuals susceptible to acute and chronic injuries. Muscle imbalances result in specific patterns in the body(6). Janda has proposed three patterns in the context of abnormalities and muscle imbalance, categorizing these patterns into three types: Upper Cross Syndrome (UCS), Lower Cross Syndrome, and Layer Syndrome. Upper Cross Syndrome primarily affects the neck and shoulder girdle. In this syndrome, the primarily tonic muscles of the upper back and anterior neck region become shortened, while the primarily phasic muscles of the deep anterior neck and lower back muscles weaken(7).

Upper Cross Syndrome according to Janda is often accompanied by abnormalities such as forward head posture, forward shoulder posture, and thoracic kyphosis, leading to extensive changes in the upper quarter of the body. In this syndrome, forward head posture alters the resting position of the mandible and respiratory difficulties occur due to increased activity of accessory respiratory muscles. Mouth breathing also changes due to displacement of the resting position of the tongue, and there is a possibility of temporomandibular joint osteoarthritis, which leads to chronic neck pain(7). Given the occupational status of carpet weavers, it seems that this syndrome is common in these individuals. The findings of Sharafi

et al indicate a prevalence of 80.4% musculoskeletal disorders among the studied weavers, with the highest reported disorders being in the back and shoulders at 52% and 49.6%, respectively, while the lowest prevalence was observed in the elbows and legs at 20% and 26%, respectively(8).

Unfortunately, there haven't been many scientific studies conducted on women carpet weavers to address and mitigate the problems arising from their working conditions and to provide appropriate exercise programs. There is a serious gap in this important area. Perhaps the reason for less attention to this issue is the limited regions in the world where carpet weaving is prevalent in terms of employment opportunities. Carpet weaving is considered a sedentary occupation, requiring weavers to work in a seated position with a bent back for long periods(9). Considering the significant role of this group of workers in the country's economy and the importance of their health in achieving sustainable development, the researcher aims to investigate the effects of 8 weeks of corrective exercises on Upper Cross Syndrome in women carpet weavers in order to find an appropriate exercise program to improve and reduce symptoms in these areas.

Materials and Methods

Given the intervention of corrective exercises and the targeted selection of participants based on entry and exit criteria, the present study is of a quasi-experimental design. Initial screening of samples was carried out through the use of a chessboard pattern ($r = 0.89$) and a flexible ruler ($r = 0.93$) by the researcher. The participants in the study were women carpet weavers aged between 35 to 45 years. 30 eligible participants simultaneously affected by forward head posture, forward shoulder posture, and kyphosis were purposefully selected and randomly assigned to two groups: an experimental group with a selected corrective exercise program (15 participants) and a control group without exercise (15 participants). None of the volunteers in this study had a history of fractures, surgeries, or joint diseases, especially in the spinal column, shoulder girdle, and pelvis, skeletal-muscular misalignments, or body weight outside the normal range. Having a work experience of more than three years in carpet weaving, experiencing forward head posture, forward shoulder posture, and kyphosis, and being within the age range of 35 to 45 years were considered as entry criteria for the study. Additionally, individuals were excluded from the study if they had diabetes, specific musculoskeletal problems, limb defects, cardiovascular diseases,

lumbar disc herniation, cervical spine disorders, neck and shoulder surgeries, spinal column disorders, or if they were pregnant. After being informed about the research procedures, volunteers read and signed an informed consent form. Demographic information such as age, height, weight, and body mass index (BMI) was also recorded for all participants. Then, a pre-test was conducted on all groups.

To measure the forward head angle, a goniometer was used, with a fixed arm attached to maintain its vertical position. The individual stood in a comfortable position and performed three flexion and extension movements of the neck, then kept the head in a natural and comfortable position. At this stage, the examiner, standing to the left of the participant, positioned the fixed arm of the goniometer perpendicular to the ground, aligned the axis of the goniometer parallel to the lateral view of the C7 spinous process, and adjusted the moving arm of the goniometer onto the anterior cartilage of the ear. The angle between the moving arm and the horizontal line passing through the C7 vertebra was recorded as the craniovertebral (CV) angle. The number closest to the indicator needle represented the angle, and if the needle fell between two numbers, the smaller number was recorded. The validity of this method has been reported as 95% (10, 11).

To measure the degree of forward shoulder posture, a Double Square ruler was used. In this method, the individual was instructed to stand against a wall in a normal standing position with hands freely by their sides, with a distance of 20 centimeters away from the body. In this position, the distance from the anterior aspect of both acromions to the wall was measured. This measurement was performed for both right and left acromions. The average distance of the right and left shoulders from the wall minus 20 centimeters was considered as the distance of the wall from the acromion. Kluemper and Hazelrigg have confirmed the validity and reliability of using the Double Square ruler(12).

To measure the kyphosis angle, a flexible ruler was used. In this method, the spinous processes of the C7 and T12 vertebrae were determined as the starting and ending points of the thoracic kyphosis curve. To calculate the kyphosis angle, after obtaining the values of H and L representing the height and depth of the kyphosis curvature from the alignment of the ruler on the backs of the participants, they were inserted into the formula $\theta = 4 * ARCTAN (2H/L)$ to calculate the kyphosis angle (13).

In the current study, exercises were applied for a duration of 8 weeks, with three sessions per week, each lasting 45 to 60 minutes. The exercises focused on simultaneously

correcting the abnormalities related to forward head posture, forward shoulder posture, and kyphosis (Upper Cross Syndrome), and were designed in consultation with corrective exercise specialists. Considering the simultaneous investigation of these three conditions, it was necessary to strengthen the weakened muscles associated with this syndrome, such as the sternocleidomastoid, upper trapezius, levator scapulae, shoulder elevators, and major and minor pectoral muscles(14). The exercises comprised a combination of stretching, strength training, and self-mobilization activities (Table 1). It's worth mentioning that all prescribed exercises in this program were designed systematically based on specialized texts and previous research recommendations (15, 12, 16). Following the implementation of the 8-week exercise protocol, all assessments were conducted as post-tests for the two groups in the study. Subsequently, after collecting the research data, descriptive statistics were utilized for variables such as mean, standard deviation, etc. For statistical inference and hypothesis testing, the ANOVA method for repeated measures was employed at a significance level of 0.05 using SPSS software version 21.

Table 1. Summary of Experimental Exercises in the Research

Exercise Name	Exercise Description
1. Isometric Neck Exercises	Creating resistance using hands towards the sides and forward (flexion) for 10-20 seconds, 3 repetitions
2. Shoulder Retraction	with Band Pull and Chin Tuck | 10-25 repetitions
3. Shoulder Joint Muscle Strengthening	with Band | In a standing position with one foot forward, hold the band with the front foot, open hands from the sides to shoulder level, then move downwards. 6-15 repetitions
4. Self-mobilization of the thoracic spine	Laying a foam roller under the shoulders and upper back, knees bent at 90 degrees, feet flat on the ground while hands are behind the head, lifting the torso off the ground
5.Pectoralis Stretch on Foam Roller	Extend your body on the foam roller so that your head and spine are resting on it. Keep your elbows at a 90-degree angle, with your arms open to the sides. Then bring the palms of your hands together. Repeat 10-25 times
6. Strengthening the back muscles with resistance band exercises	Bent-over fly. 6-15 repetitions.
7. Stretching the chest and front arm muscles using the wall	10-20 seconds, 3 repetitions
8. Strengthening the middle and lower trapezius	Lying on the stomach with elbows bent at a 90 degree angle in line with the shoulders. Gradually, the movement becomes more challenging as the arms move upwards and then return downwards.
9. Strengthening the back muscles	(Seated shoulder stretch). 20-10 seconds, 3 repetitions

Results

The demographic characteristics of the participants are presented in Table 2, and the statistical information for the experimental and control groups is provided in Table 3. According to the data available in Table 3, the corrective exercise program had a significant effect on reducing head and kyphosis angles in the experimental group participants, but no significant effect was observed on forward shoulder posture. Additionally, no significant differences were observed in head forward and kyphosis angles, as well as shoulder forward posture, in the control group after eight weeks ($p \geq 0.05$).

Table 2. General Statistical Information Related to Demographic Characteristics of Participants

Factor	Group	Mean ± SD
Age (years)	Experimental	45.36 ±8.17
	Control	43.60 ±9.12
Height (centimeters)	Experimental	159.64 ±5.032
	Control	160.60 ±9.33
Weight (kilograms)	Experimental	66.86±9.32
	Control	65.40±17.08

Table 3. Statistical Information of Participants in the Experimental and Control Groups at Pretest and Posttest (Standard Deviation ± Mean)

Variable	Source of Changes	Experimental Group	Control Group	Interaction
Forward Head Angle (degrees)	Pretest	20/92±4/2	16/40±3/2	F= 7/57
	Posttest	16/54±3/2	16/20±3/1	P= 0/01
Forward Shoulder Posture(centimeters)	Pretest	31/50±2/8	32/20±3/4	F= 3/76
	Posttest	30/36±3/1	32/20±3/3	P= 0/06
Kyphosis Angle (degrees)	Pretest	48/83±4/1	46/57±3/4	F= 3/42
	Posttest	44/36±3/8	47/0±3/6	P= 0/008

Discussion

The results of the current study demonstrated significant differences in the variables of forward head posture and kyphosis between the experimental and control groups ($P \leq 0.05$), favoring the experimental group.

A notable distinction of this study from previous research was in determining the effects of corrective exercises on upper cross syndrome resulting from occupational conditions. Various exercises including stretching, strengthening, stabilization, and mobilization exercises with different intensities and durations were utilized in this study. The test results in the experimental group indicated a significant reduction in the forward head posture and kyphosis angles of the participants after participating in the corrective

exercises ($P \leq 0.05$). However, no significant difference was observed in the degree of shoulder protraction. As the findings indicated, the mean forward head posture angle in the experimental group decreased from 20.92 degrees in the pretest to 16.54 degrees in the posttest, demonstrating the effectiveness of the selected corrective exercises. This is consistent with the results of previous studies by Vali et al.(17), Diab et al(18), Hosseini et al(19), Seyedi(20), and Khazaei et al(21). Designing a corrective program consisting of stretching exercises for shortened muscles and strengthening exercises for weakened muscles in a localized manner can help correct muscular imbalance and lead to a reduction in the degree of forward head posture in individuals afflicted with this condition(14). In the current research program, efforts were made to strengthen the neck flexors in individuals with forward head posture. Studies have indicated that strength exercises increase blood flow, resulting in improved blood circulation and nutrient delivery to cells, thereby promoting relaxation. Additionally, considering that the primary benefit of stretching exercises is to improve joint range of motion and increase the elasticity of muscles, ligaments, and other connective tissues, shortened muscles tend to improve through this process(22). Based on the results, it can be confidently stated that the corrective exercises applied in this study were effective in correcting forward head posture. However, considering the lack of significant reduction in the forward shoulder posture of individuals in the experimental group following participation in the corrective exercise program compared to the control group, it can be concluded that the corrective exercise program used in this study did not have a desirable effect on correcting forward shoulder posture. The average forward shoulder posture of participants in the study was 31.50±2.27 centimeters in the pretest and 30.36 ± 1.49 centimeters in the posttest. The results of the current study did not align with the findings of Harman et al (23), Najafi and Behpoor (24), Danshmandi et al (16), and Hajhosseini et al (25). The weak shoulder status and muscular imbalance around the shoulder are important indicators of shoulder abnormalities and chronic pain syndromes. The muscles that stabilize the shoulder are attached to the medial border of the scapula and control its position(15). The main stabilizers of the shoulder girdle are the rhomboids, levator scapulae, trapezius, and serratus anterior. This muscular structure primarily controls shoulder movements in all coordinated contractions and paired forces, so that the muscles controlling movement or joint position act synergistically. The position of the shoulder on the chest wall affects its function, and its abnormal position can lead to movement disorders.

These biomechanical changes resulting from abnormal alignment can affect joint forces, mechanical efficiency of muscles, and proprioceptive function(26). As the distance between the shoulder bones moves away from each other, we observe a forward shoulder posture. Additionally, a study reported that protracted shoulders result from pectoralis minor muscle tightness and weakness of the middle trapezius. Researchers have also stated that weakness in shoulder adductor muscles such as the serratus anterior and rhomboids leads to increased shoulder girdle distance and muscle deconditioning, resulting in forward shoulder posture(15,25). According to the general principles of corrective and therapeutic exercise programs, strengthening weakened muscles leads to biomechanical realignment and proper alignment of abnormal areas. In the current research program, by stretching shortened muscles and increasing their length, and by strengthening weak muscles, there was a slight reduction in the forward shoulder posture. In fact, it can be argued that the design and implementation of a precise and targeted corrective exercise program consisting of stretching, strengthening, and mobilization exercises for the neck, shoulder girdle, and arm joints, performed regularly and under direct supervision, can have a desirable effect in reducing forward head and shoulder posture in affected individuals(22). This program was designed in such a way that during exercises, the muscles of the upper extensors and lower flexors of the neck, as well as the chest muscles and arm internal rotators, were simultaneously stretched, while stress on the lower extensor and upper deep flexor neck muscles, as well as the shoulder adductor and arm external rotator muscles, was reduced. This was aimed to strengthen their ability to maintain proper posture. Therefore, to achieve these goals, participants were instructed to perform movements such as torso straightening, chin tucks, retraction, external rotation of the arms, and bringing the shoulders closer together simultaneously and in a specific sequence (depending on the type of each exercise), while avoiding breath-holding during all stages of execution. Additionally, in terms of exercise intensity progression, emphasis was placed on increasing duration and maintaining proper posture in each exercise to improve muscular endurance(22). In the exercises, attention was also paid to stretching the chest muscles and strengthening the posterior muscles to correct kyphosis. The exercise program was predominantly closed kinetic chain and performed under weight-bearing conditions to be closer to real-life situations. The improvement in the kyphosis angle from 48.83 ±6.77 degrees in the pretest to 44.36±5.13 degrees in the posttest in the experimental group demonstrates the effectiveness of this

exercise program. This finding is consistent with the results of Khazaei et al (28). In previous studies, strength exercises have been used to increase the strength of the spine extensor muscles in individuals with kyphosis, and it has been observed that strengthening the spine extensor muscles plays a crucial role in maintaining posture. These types of exercises can help improve kyphosis abnormalities in affected individuals. Given that the spine extensor muscles are among the most important muscles in maintaining posture, strengthening this muscle group can help strengthen the spine and ultimately reduce abnormality(27).

Competing interests

There is no competing of interest to disclose.

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