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Seated Exercise Therapy Improves Posture and Balance in Hyperkyphotic Elderly Females, a Randomized Control Trail

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Abstract: This study aimed to investigate the effect of seatedexercise therapy on the posture and the balance inhyperkyphotic elder women.In this study 23 hyperkyphotic females, aged 60 years and older, were randomly divided, into experimental group(n=12) and control group (n=11). The experimental group exercised 3 sessions per week for12 weeks, 60-90 minutes per session. Before and after exercise program their kyphosis angle was measured by using of flexible ruler. Their balance was measured by using of Berg balance scale. The results showed no significant difference between two groups (experimental and control) in the balance, kyphosis angle, height and forward head at pretest ($p \leq 0.05$). There was a significant difference between kyphosis angles from pre (49.33±4.61) to post test (41.33±4.24) in experimental group ($p \leq 0.05$). Moreover, the results showed that the seated exercise therapy causes significant changes on the height, the forward headand the balance of the elder people ($p \leq 0.05$). However, there was no differencebetween thepretest and the post test in thecontrol group in any variables.The results of this study confirm the role of seated exercise therapy in reducing the angle of kyphosis and improving balance in older adults.

Key words: Elderly · Kyphosis · Balance · Exercise therapy

INTRODUCTION

Reduced functional ability and decreased capability to perform daily activities relate to increased kyphosis angle in elderly. Aging is a phenomenon that can be consider as the natural course of human life [1]. Aging causes some changes in the functions of physiological systems which are involved in the balance. At the present a large amount of any countryconsist of elderly population [2]. According to the World Health Organization (WHO) aging period is a border crossing at 60 that people survived from the events of life and passed youth andmiddle age [3]. It is suppose that aging process will bring noticeable problems in different tissues in all of the body. It has been guessed that most of these problems are because of misuse or disuse till by aging itself [4]. It is obvious that with increasing age, the risk of acute and chronic diseases increase and their functional abilities, understanding and their senses power is reduced [5]. Age-related changes in posture commonly include a forward head, rounded shoulders, increased thoracic kyphosis,reduced lumbar lordosis and flexed hips and knees. These changes are generally attributed to gradual changes in thestructure and mechanics of connective tissues which result in a loss of elasticity and inability to effectively counteract the gravitational torque that pulls the body into a forward bent position. Certainly, muscle weakness can also affect posturalalignment [6]. The aging process changes normal postural directionand kyphotic posture often increases with age [6, 7]. Insufficiency in back extensor muscles and decreased shoulder and hip range of motion have been correlated with kyphotic posture [7, 8] and is characterized by an increased curvature ofback spine (kyphosis), forward head posture and decrease in stature [8, 9]. Postural kyphosis may occur in both old and young people [10] and as much posterior curve (arch) of the spine (usually the thoracic spine) is defined [11]. Ageing kyphosis is a kind of phenomenon that with increasing age, changes in the curvature of the spine, particularly the thoracic curve reveals [12]. The prevalence and incidence of hyper kyphosis in older persons is probably between 20% and 40%. A longitudinal study of 100 healthy males and females aged 50 years or older (mean age, 62 years), reported a mean thoracic angle increase of 3° per decade. For example, one study of men and women reported mean

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thoracic kyphosis angles of 26° in persons in their 20 s,53° in those 60 to74 years of age and 66° in those older than75 years of age [9]. Some researchers have suggested that the posterior arch is acceleratingin the seventh decade of life [12]. The normal kyphosis is 20-40 degrees, if this angle is greater than 40 degrees is considered as abnormality. Studies have shown that an increase in angle of kyphosis in adults is related to decline physical function, impaired balance, slow gait, decreased functional ability and alsoimpaired ability to perform daily duties [13].

Balance, or the ability to control postural sway, worsens with age and this age-related decline has been associated with increased fall risk [14, 15]. The second most common cause of death in elderly people aged 65 years or older is accidental falls [16]. One- third of persons age 65 or older will have one or more falls per year. Many factors may affect to an older adult falling. A number of studies have demonstrated a strong positive correlation between poor balance, abnormalities of gait and falling among elderlyadults [17]. Decline in postural stability control is influenced by inactivityor low physical activity [18]. The common method to prevent or treatment of this problem in the seniors (impaired balance) is practice of physical activities in rehabilitation [19]. Studies have shown that in aged people, exercise therapy training can help to maintain and promote their balance ability significantly [16]. Exercise therapy is a treatment in which the active exercise (by a person) and non-active (coach) is accomplished. The purpose of the exercise, is prevention and rehabilitation following the occurrence of physical abnormalities and maintain proper postural stability [12]. The most important targets of therapeutic exercises arerelieving pain, improving physical function and promoting vital capacity [20]. Previous investigations have shown that daily physical activity and exercise training can reduce the incidence and risk of falls [16, 21]. Lazowski *et al*. demonstrated that general physical training has a positive influence on balance in institutionalized frail elderly subjects, while Rubenstein *et al*. showed that physical training based on strength,endurance and mobility can progress balance in fall-proneelderly subjects [22]. Brown and Holloszy reported that, following 3 months of flexibility and strength training, adults age 60 and older showed no change in measures of gait and only women improved their balance with eyes opened whereas Crilly and colleagues designed a 12-week exercise program to improve postural stability among 50 older females. Following treatment, the participants of exercise group demonstrated no improvement in postural sway over controls [17]. Katzman and colleagues reported that, following 12-week training there was a significant improvement in kyphosis angle but no changes in balance in elder women [8]. Despite extensive studies in the field of postural correction in older people, it seems there is less attention to the same effects of exercise therapy on posture and balance. However, the relationships between physical activity and balance ability in aged people still remain unclear. Therefore, the purpose of this study was to investigate the effect of exercise therapy on posture and balance in elderly kyphotic women.

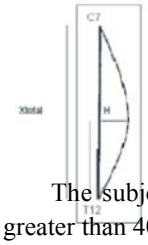
MATERIALS AND METHODS

Subjects: The population targeted for this study was women aged 60 years and older with kyphotic posture. The 23 subjects included in the study,with a mean age of (67.13±4.05), were randomly divided into two therapeutic (n=12) and control (n=11) groups. Participants were required to have a thoracic kyphosis of 40° or greater. The subjects were healthy, community dwelling, did not have neurological and/or psychiatric disorders, did not show signs of any serious cognitive dysfunction, did not use a cane or walker for daily living, with no history of falling and could shuttle walk over 6 m (about 10 steps) by themselves. Approval to participate in a moderate-intensity exercise program was required from a primary care physician.

Balance: Balance was assessed using Berg Balance Scale (BBS). This instrument is used to assess balance and risk of falls in elderly and takes into account the effect of environment. This scale uses 14 tests to assess subjects' skill to sit down, stand up, reach, turn around them, look over the shoulders, stand on one foot and go upstairs. Total score is 56 and any rate equal or below 36 is associated with 100% risk of falls [23].

Flexed Posture: A surveyor's flexi curve was used to measure the size of the curve (ie, kyphosis) in the thoracic spine and estimate postural stiffness. The flexi curve is a 60-cm-long flexible piece of lead covered in durable plasticthat can be molded to the contour of the spine to measure curves in the sagittal plane. The flexi curve provides a quick, inexpensive and noninvasive way to assess posture in clinical or community-based settings. Several investigators have established the validity of flexi curve postural measures by correlating them with measures of kyphosis and vertebral wedging taken

from spinal radiographs and other instruments such as goniometers, kyphometers and inclinometers [6]. The measurement of kyphosis was performed by main researcher in with a standard protocol. The seventh cervical (C7) vertebra's process was located by having the subject bend her head down and palpating the first prominence at the lower end of the neck; it was marked with a dot made with a pen. The 12th thoracic (T12) vertebra's process was identified by palpating and counting 12 prominences on the spine caudally under C7 and marked with a dot made with a pen. After the vertebra'sprocess was located and marked, the subject was asked to relax and stand in their usual posture with arms swinging gently at the sides. Each subject was instructed to stand without shoes on and with weight equally distributed on both feet. With the examiner standing facing the side of the subject, the flexi curve was placed on the spine and shaped to fit the contours of spinal curve. The instrument was carefully removed and traced onto a piece of plain white paper. A vertical line was drawn to connect the C7 and T12 landmarks. The maximum width and the total length of the thoracic curve was measured in centimeters and used to calculate the index of kyphosis using the following formula:



$$\theta = 4Arc\tan g\left(\frac{2H}{L}\right)$$

L=length

H=width

The subjects whose calculated degree was equal or greater than 40° placed in kyphotic groups.

Their height was measured by using of tape –measure which was fixed on the wall. The distance of forward head were measured by using of plumb-line and posture screen. Exercise therapy included of 12 weeks and 3 sessions per week. Exercise times per session were 40 minutes for first month, 60 minutes for second month and 90 minutes for third month. Ten minutes of exercise time were for warm up and 10 minutes were for cool down. The training program included of 10 exercises in sitting position. The exercises included of 1) flexion and extension of thoracic spine, 2) closing door, 3) rowing, 4) spinal rotation to left and right, 5)lateral flexion with stretch arm, 6) arms hyperextension with towel, 7) cervical retraction, 8) cervical rotation to right and left, 9) chest press, 10) stretch truck with arms up. Repetition of exercises was increased per week. Post-test was done for two groups at the end of exercise training.

RESULTS

Twenty three kyphotic female participated in the exercise training and at the end of program completed the posttest protocols. The participants' characteristics were shown in Table 1.

Table 2 demonstrates comparative results in two groups before and after exercise therapy. The experimental group shows significant increase in height. Auricle distance from plummet line and kyphosis angle decreased significantly in the participants of exercise group. Balance scores of experimental group increased from pretest to posttest too ($p \leq 0.05$). However there were no significant changes of any variables in control group ($p \leq 0.05$).

Table 1: Participants' characteristics

Characteristics	Age(years)	Height(cm)	Weight(kg)
Experimental group	67.41± 4.23	149.65±5.11	66.66±11.61
Control group	66.81±4.04	150±4.15	68.81±11.31

Table 2: Pretest and post test results of two groups

Groups	Stage	Height	Forward head
Control (n=11)	Before	150. 64±4.15	4.36±1.46
	After	150.91±4.61	4.36±1.46
Exercise training (n=12)	Before	147.75±5.52	6.45±2.42
	After	149.50±5.90 *	5.37±2.27 *

*Significant differences between pretest and posttest ($p \leq 0.05$)

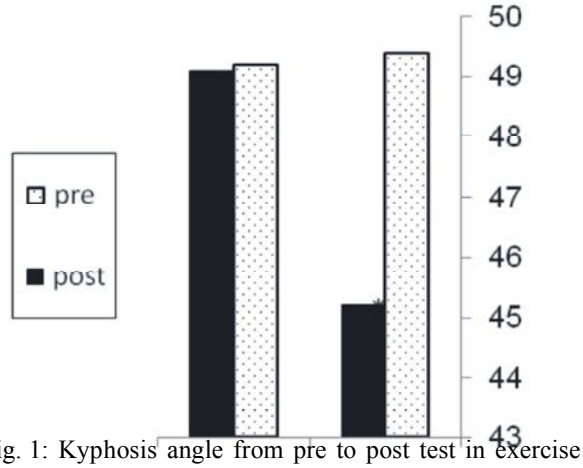


Fig. 1: Kyphosis angle from pre to post test in exercise (Ex) and control group (Co)
*Significant decrease compare to pretest in exercise group ($p \leq 0.05$)

Fig. 2: Balance scores of exercise (Ex) and control group (Co) from pre to post test
*Significant increase compare to pretest in exercise group ($p \leq 0.05$)

Figure 1 shows kyphosis angle and Figure 2 shows the balance score changes in two groups.

DISCUSSION

Postural stability,Muscle strength and balance decrease with aging [24]. Normalpostural direction and kyphosis curvature have been changed by aging process. Thoracic kyphosis and protrusion of the head and in more severe cases, knee flexion, characterizeshyper kyphosis posture with increasing age [7]. Few studies have been developed regarding seated exercise therapy in hyperkyphosispostured females [25]. The present study demonstrated that seated exercise training realized over a period of 12 weeks was effective in improving kyphosis angle.The exercise training causes to increase height in experimental group from pretest to posttest. Forward head of the participants of exercise therapy improved too.

Based on the well-known concept, back extensorsweakness is definitely recognized as a key element in thepathophysiology of flexed back [7]. Madureira *et al*. (2007) stated that programs with emphasize balance training are more effective for improving balance than those that consist primarily of aerobic, muscular strength or flexibility exercises [26]. Nevertheless in this study exercise program didn't emphasize on balance training. Exercises for strengthening of back extensor muscles were included in the seatedexercise therapy protocol. The results support our primary hypothesis that a simple safe program adapted to the strengthening of back extensors and flexibility of forward extensors iseffective in improving flexed posture in the elderly. Moreover, exercise program had positive effect on balance score in Berg balance scale that measured static and dynamic balance.

There are many causes of balance disorders and vary from one person to another. Disorder of the internal ear or vestibular end-organ type is one cause. Unsteadiness of somatosensory or proprioception is common in the aged persons so is degenerative disturbanceof central nervous system. The seniors are prone to many chronic diseases or disorders which are causes of balance disorder or give rise to more rapid degeneration of the central nervous system i.e. high blood pressure, obesity, diabetes mellitus, end stage renal disease, heart disease, proprioception neuromuscular and joint problems, arthritis and muscular weakness due to lack of good health, daily physical activity and exercise [27, 28]. In this study, short period exercise training (12 weeks) causes to improve balance that may be due to many reasons such as back extensor muscular strength, improvement of somatosensory, move the center of gravity and many other reasons. This finding is in contrast with Katzman and colleagues that reported significant improvement in kyphosis angle but no changes in balance in elder women following 12-week training [8].

CONCLUSION

The seated physical activity program adapted for elderly female with hyperkyphotic posture improved postural alignment and increased height. The increasing of back extensors strength and the increasing in the flexibility of pectoralis, correspond to the reduction of kyphosis angle and forward head. These changes were associated to improve Berg balance scale too. It can concluded that the short simple seated exercise therapy may improve the posture and balance statues of elderly hyperkyphotic females.

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