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Research Article

Investigating the Relationship between Upper Extremity Functions and Kyphosis Angle in Elderly Women

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Abstract

Objectives: The aim of this study is to examine the relationship between upper extremity functions and angle of kyphosis in elderly women.

Materials and Methods: Sixty-four female mean age of 71.29 ± 4.2 years were included in this study. Spinal Mouse Device, Held-Hand Dynamometer, Goniometer, Upper Extremity Functional Index (UEFI) and Minnesota Placing Test (MPT) (Minnesota Manual Dexterity Subtest) were used for angles of kyphosis, muscle strengths, range of motions, upper extremity functionality and hand skills of subjects respectively.

Results: Mean age, height, weight and Body Mass Index of subjects were 71.29±4.2, 163.45±5, 81.79±10.5, 30.58±3.3 respectively, while angles of kyphosis, MMDT scores and UEFI scores were 57.42±7.4, 72.96±11.6, 73.45±4.2 respectively. A statistically significant and moderate level negative association was determined between UEFI and angle of kyphosis. (r= - 0.42 / p=0.001). On the other hand, a statistically significant and low level positive association was determined between MPT score and angle of kyphosis (r=0.32 / p=0.01).

Conclusion: Hyperkyphosis occurring with age leads to a reduction of the speed and the ability to functions with activities of daily living including the upper limbs. Therefore, measures of hyperkyphosis need to be taken in early stage and individuals should be informed about this issue. It is thought that the arrangement of rehabilitative programs in first step will be useful in terms of prevention of reduction of functionality in old age.

Keywords: Kyphosis; Hyperkyphosis; Upper extremity function; Body Mass Index

Introduction

Vertebral colon is a column, which consists of 34 vertebrae and the disc between these vertebrae, and this structure has backward and forward curves in sagittal plane [1,2]. The degenerative changes that are seen along with the aging result in differentiations in structure of vertebral colon. In 2/3 of women and 1/2 of men in elderly population, the increasing in kyphosis is observed [2-5]. Because of the support of vertebral colon to upper body and the localization of thoracic vertebrae, the differentiations in thoracic region negatively influence the structures in lower and upper segments. Increasing kyphosis in thoracic region may cause shoulder, neck, back and lumbar pain, as well as it may be the reason for respiratory problems by negatively affecting the mobility of costae, where the thoracic vertebraejointed to. Besides that, the increased thoracic kyphosis also alters the position of scapula-thoracic joint and consequently that of scapula. Because of the important role of scapula on the shoulder mobility, the changes in position of scapula may result in the problems in shoulder joint. The problems related with the shoulder joint cause limitation in daily life activities of specially the elderly people [4-8].

In literature, there is limited number of studies on thoracic kyphosis in elderly population. Considering the results of these studies, it can be seen that there is a negative relation between the increased kyphosis of elderly people and the muscle strength. Besides that, it has also been reported that increased thoracic kyphosis in adults underlies the sub-acromial impingement syndrome. Although restoration of kyphosis posture has an important role in both of protecting from the shoulder problems and treatment of these problems, it has been emphasized in literature that the relationship between the kyphosis and shoulder problems and upper body functionis not sufficiently understood [5,9,10].

Even though there is a close relationship between the increased kyphosis in thoracic region and the shoulder complex, there is limited number of studies on examining the relationship between thoracic kyphosis and shoulder function. For this reason, the present study was planned in order to examine the effects of thoracic kyphosis on the functions of shoulder complex that has vital importance for daily life.

Materials and Methods

In this study, 64 healthy individuals aged more than 65 years and having no history of operation in neck, back, and upper extremity regions were involved. The exclusion criteria were determined to be the function loss in upper extremity due to any disease or trauma such as rheumatologic diseases, neurological disorders, or orthopedic diseases. All of the subjects were informed prior to the

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Table 1: Demographic characteristics of the subjects.

Variables (n=64)	X±SD
Age (year)	71.29±4.2
Height (cm)	163.45±5.0
Weight (kg)	81.79±10.5
BMI (kg/m²)	30.58±3.3

cm: centimeter; kg: kilogram; m²: square meters; n: number of case; SD: standard deviation; X: average.

examination, and their informed consents were obtained. Also, this study was funded by Scientific Research Projects Coordination Unit of Dumlupinar University (Project Number: 2014-11). The demographic data of subjects such as age, height, weight, and BMI were recorded in prepared form.

In present study, the thoracic kyphosis angles, muscle strengths, range of motions (ROM), upper extremity functions, and hand skills of the subjects were evaluated. The results of these evaluations are presented below.

Measurement of thoracic kyphosis angle (posture evaluation system)

Spinal Mouse Device used for measuring the thoracic kyphosis angle. Spinal alignment in vertebral colon was measured by using a procedure, which was documented in 2004, in standing position [11]. Spinal mouse was movedfrom T1 to T12 in standing position. The positions of joint edges of T1 and T12, which consists of the interrelated movement of both vertebras, were measured in orderto determine the thoracic kyphosis angle [12]. In order to minimize the errors, the measurements were repeated in three times, and the mean values were recorded.

Muscle test

In order to measure the muscle strength, Manual Muscle Test System™ hand-held dynamometer (HHD) was used. Prior to the test, each of the subjects was verbally informed about test procedure. "Make Test" method, which requires isometric contraction during the test, was used. Make Test is the protocol, where the practitioner holds the dynamometer stable and the person subjected to the measurement applied force against the device [13]. Before initiating the test, the subjects were asked to perform sub-maximal contraction against the hand of practitioner in order to reveal the accurate movement. After each of muscle tests, the subjects were asked to maintain the maximum isometric contraction for 5 seconds (sec.). The mean value of 3 subsequent maximum contraction measurements performed with 30sec interval was computed.

The muscle test was performed for shoulder flexion, abduction, external rotation, and internal rotation.

Evaluation of ROM

Goniometric measurement was utilized for evaluating the ROM. The subjects were informed prior to test about the position, requested movement, and the requested speed. ROMs of shoulder flexion, abduction, and internal and external rotation were evaluated [14].

Upper Extremity Functional Index (UEFI)

Evaluation of the subjects' upper extremity functions was performed using UEFI. UEFI consists of 20 items, where it is questioned if the subjects have difficulties in different upper extremity activities. Each item is scored between 0 and 4, and the total score is 80. Higher scores indicate better function, while lower scores mean worse functional status. 0: Excessive difficulty or inability, 1: high level of difficulty, 2: mid-level of difficulty, 3: mild difficulty, 4: no difficulty [15].

Table 2: Muscle strength and range of motion values of the subjects.

	Variables (n=64)	X±SD
MuscleStrength Test (Newton)	**ShoulderFlexion**	
	Right	87.76±26.7
	Left	89.53±27.2
	ShoulderAbduction	
	Right	89.54±21.6
	Left	95.12±5.0
	ShoulderInternalRotation	
	Right	72.21±20.9
	Left	73.01±3.0
	ShoulderExternalRotation	
	Right	55.78±19.8
	Left	70.21±6.0
Range of Motion (Degree)	**ShoulderFlexion**	
	Right	146.84±6.4
	Left	165.31±5.0
	ShoulderAbduction	
	Right	136.15±6.8
	Left	141.98±16.6
	ShoulderInternalRotation	
	Right	75.23±5.1
	Left	77.52±7.8
	ShoulderExternalRotation	
	Right	62.21±22.6
	Left	60.12±20.1

n: number of case; **SD**: standard deviation; **X**: average.

Minnesota Manual Dexterity Test (MMDT)

Within the scope of present study, MMDT was employed in order to evaluate the hand-arm skills, and upper extremity endurance and performance of subjects. Among 5 sub-tests constituting this test, the Minnesota PlacingTest (MPT) was employed in present study. The flexion and extension movements of shoulder and elbow joints are required for the test. Considering the importance of these joints in daily life activities, this test was chosen. While in sitting position, the subjects were asked to immediately place 58 discs, which were placed in front of the test table, on the table having 58 gaps on it, and the results were recorded as second [16].

Statistical analysis

The analysis of obtained data was performed by SPSS for Windows 20.0 program. Descriptive data was presented by mean values and standard deviation. The correlation between kyphosis angles and muscle strength, ROM, speed, and functionality of upper extremity was analyzed using Pearson's correlation coefficient and significance test.

Results

64 female subjects having mean age of 71.29±4.2 years were involved in the study. The demographic data of subjects are presented in Table 1. Mean muscle strength and ROM of subjects were shown in Table 2, while the results regarding the mean kyphosis angle and upper extremity functionin standing position were presented in Table 3.

In this study, the relationship between the kyphosis angle and

Table 3: Kyphosis angles and upper extremity functions of the subjects.

Variables (n=64)	X±SD
Kyphosis angle (Degree)	57.42±7.4
MPTS (second)	72.96±11.6
UEFI	73.45±4.2

n: number of case; **SD:** standarddeviation; **X:** average; **MPTS:** Minnesota PlacingTest Score; **UEFI:** Upper Extremity Functional Index.

Table 4: Examination of the relationship between kyphosis angle and upper extremity functions.

Variables	Kyphosis angle r/p
MPTS (second)	0,32/**0,01***
UEFI	-0,42/**0,001***

p: level of significance; **r:** coefficient of variation; **MPTS:** Minnesota Placing Test Score; **UEFI:** Upper Extremity Functional Index.

upper extremity function of subjects was investigated, and the obtained measurement values were presented in Table 4. Statistically mid-level negative relationship was found between UEFI and kyphosis angle (r= - 0.42 / p=0.001), while statistically significant low-level positive relationship was determined between MPT score and kyphosis angle (r=0.32 / p=0.01).

Discussion

As a result of this study, it was determined that increasing kyphosis angle of healthy elderly women caused decrease in upper extremity functions including the skills and speed. Increase in thoracic kyphosis is a common state affecting 2/3 of elderly population [17]. In relation with the thoracic backache, the decreased muscle strength, limited daily life activities, and mortality were defined [18,19].

In literature, the reason for the effect of increasing thoracic kyphosis on upper extremity functions was shown to be the increase in thoracic slope, and the more protracted, descending, and forwardly-slopedscapula in downwards direction [20,21]. Moreover, this 3D position causes sub-acromial impingement syndrome by declining the sub-acromial area. The higher incidence of impingement syndromes and rotator cuff rupture among the elderly population has been reported to be caused from thoracic kyphosis increase and consequent change in position of scapula [22,23]. The limitations of upper extremity movement and physical function have been shown to be caused from the limitation of scapular movement in relation with the increase in thoracic kyphosis [21,24,25]. Moreover, it lays the foundation of daily life activities such as upper extremity ROM, dressing, personal care, and hygiene [25,26].

Chow and Harrison, in their study on women in post-menopausal period, have found important relationship between the kyphosis index and maximum oxygen consumption and bone's calcium density [18]. In year 1997, Ryan and Fried have reported the relationship between the kyphosis and the decreased function and decreased performance in tasks requiring mobility [27]. Kadoet al. have carried out a study on 1353 elderly adults, and have shown that individuals having hyper-kyphotic posture had higher mortality rates [28]. In a study on examining how the thoracic posture influences the scapular movement patterns and the range of abduction motion in scapular plane, and how the abduction in scapular plane influences the muscular force, it has been reported that the position of thoracic vertebrae significantly affects the scapular kinematics during the abduction in scapular plane and the thoracic posture significantly decreases themuscle strength of abduction in scapular plane [29].

In their study on examining the effects of sitting posture on thescapular kinematics during humeral elevation, Finley and Lee have revealed that the thoracic kyphosis significantly decreased the lateral rotation and its dislocation towards posterior [21]. Ludewiget al. have reported in their study that, in order to understand the shoulder pathologies related with the abnormal scapular kinematics, it might be necessary to evaluate the scapular slope, internal rotation, and upwards rotation [30]. In this study, it was also determined that, when the internal and external rotation levels of subjects' upper extremity were compared to findings of Kendall [31], the internal and external rotation levels decreased.

In their study on investigating the relationship between kyphosis and sub-acromial impingement syndrome, Otoshiet al. have reported that thoracic kyphosis played important role in development of sub-acromial impingement syndrome by decreasing the elevation of shoulder [32]. In line with the literature, it was determined in present study that the shoulder flexion and abduction ROMs of subjects were lower than normal levels.

The results of studies indicate that the kyphosis angle is correlated with the scapula. Together with the scapular winging, the increase in kyphosis causes protraction in shoulder. And protraction results in limitation of ROM of upper extremity and loss of muscle strength. Age-related increase in thoracic kyphosis causes decrease in speed and skills, besides the functions of upper extremity including the daily life activities. Similarly, it was determined in present study that the increase of kyphosis in elderly women resulted in decrease in upper extremity functions. For this reason, the required measures should be taken in early period in order to prevent the increase of thoracic kyphosis. In this parallel, it is thought that it would be useful for increasing the functionality in elderliness to organize first-step rehabilitation programs.

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