

## Relationship between Thoracic Kyphosis and Trunk Length in Adolescence Females

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**Abstract:** This study was conducted to determine the relationship between thoracic kyphosis and trunk length in adolescence females. Ninety adolescence females complained from postural kyphosis (diagnosed by orthopedist) from preparatory and secondary schools in Cairo and Giza Governate, participated in this study. Their ages ranged from 13 to 18 and their thoracic kyphosis angle was more than 40 degrees and less than 60 degrees. They were evaluated by the Formetric II instrument in spinal shape analysis laboratory at the Faculty of Physical Therapy, Cairo University. Duration of the study was from January 2011 to March 2011. The obtained results showed a strong positive correlation was found between thoracic kyphosis angle and the trunk length ( $r= 0.960$ ;  $p < 0.01$ ). On conclusion; there is a strong positive correlation between thoracic kyphosis angle and the trunk length in adolescence females.

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**Key words:** Thoracic Kyphosis, Trunk length, Adolescence, Formetric II.

### 1. Introduction

**Ohenba and Baron (1996)** stated that slouching and poor posture can stretch the spinal ligament, thus increasing the natural curve of the spine. This postural kyphosis usually begins to develop during adolescence. It is more common among girls than boys and it rarely causes pain.

Competitive sports can stress the musculoskeletal systems of adolescent and young adult women, causing injuries and pain with the development of postural changes, spinal problems such as scoliosis and thoracic kyphosis (**Armstrong and Welsman, 1994**).

Kyphosis which occurs to compensate the breast development in girls after puberty due to carrying heavy schoolbags, participating in competitive sports and wrong posture can be cured with early diagnosis. If this kyphosis isn't cured with an early diagnosis it can cause psychosocial problems (**Kendail et al., 1993**).

Postural kyphosis, the most common type, normally attributed to slouching, can occur in both the old and the young. In the young, it can be called 'slouching' and is reversible by correcting muscular imbalances. In the old, it may be called 'hyperkyphosis' or 'dowager's hump'. About one third of the most severe hyperkyphosis cases have vertebral fractures. Otherwise, the aging body tends towards a loss of musculoskeletal integrity, and kyphosis can develop due to aging alone (**Hawes, 2006**).

Postural kyphosis is a type that mainly becomes apparent in adolescence. The onset of postural kyphosis generally is slow. It's more common in girls than in boys. Poor posture or slouching may cause stretching of the spinal ligaments and abnormal formation of the bones of the spine (vertebrae). Postural kyphosis is often accompanied by an exaggerated inward curve (hyperlordosis) in the lumbar spine. Hyperlordosis is the body's way of compensating for the exaggerated outward curve in the upper spine. Although rare, kyphosis can lead to serious health problems, such as physical deformity, breathing difficulties or damage to internal organs that are affected by the postural changes. Adolescent girls with poor posture are at a greater risk of postural kyphosis. Postural kyphosis doesn't progress and may improve on its own. Exercises to strengthen back muscles, training in using correct posture and sleeping on a firm bed may help. Pain relievers may help alleviate any pain (**Weiss and Turnbull, 2010**).

Adolescent girls between the ages of 9.5 and 14.5 years have a period of rapid bone growth. The onset of menses contributes to the acquisition of peak bone mass and is improved by regular balanced exercise and good diet. Postural kyphosis is rather easily corrected with education about proper posture and some retraining on how to sit and stand correctly. Treatment does not need to include casting or bracing. However, strengthening the back muscles can help with proper posture. Learning correct body mechanics to maintain erect posture that counteracts the effects of the kyphosis. Doing regular non-jarring

exercises, such as swimming and maintaining high levels of activity are thought to be useful advice in the management of postural kyphosis (**Nies and Kershaw, 2002**).

Adolescents who have a slouched posture that is corrected by "standing straight" usually have postural round back. Often seen in early adolescents, especially girls who are growing rapidly and developing secondary sexual characteristics, round back may reflect some degree of self-consciousness. However, with counseling and completion of physical and emotional maturation, postural round back often subsides. There is no bony problem (**Korbmache et al., 2004**).

Postural kyphosis may occur in both old and young people. In the young, it can be called 'slouching' and is reversible by correcting muscular imbalance. In the old, it may be called 'hyperkyphosis' or 'dowager's hump'. About one third of the most severe hyperkyphosis cases have vertebral fractures. Otherwise, aging process tends to cause loss of the musculoskeletal integrity. Kyphosis can develop due to aging alone (**Kado et al., 2007**).

Competitive sports can stress the musculoskeletal system of adolescent and young adult women, causing injuries and pain with the development of postural changes. Conditions commonly associated with this age group are patellofemoral problems, traction apophysitis, ankle injuries, compartment syndromes and other acute and overuse injuries. Spinal problems include scoliosis, thoracic kyphosis and spondylosis. Adolescents are particularly susceptible to growth plate injuries, especially in the mid-pubertal period, in addition to long-bone stress factors and avulsion fractures (**Nies and Kershaw, 2002**).

Positions and postures usually adopted by women can become habitual patterns. Early education and training of body mechanics normally tend to help in forming positive postural habits, optimal muscle balance and skeletal alignment. Adolescent girls have a period of rapid bone growth between the ages of 9.5 and 14.5 years. It is important to choose an exercise for kyphosis that corrects the weakness in the muscles extending up to the spine as well as forward head posture, to achieve good postural alignment and reduce strain on the muscle of the back (**Keller et al., 2003**).

## 2. Subjects, Material and Methods

Ninety adolescence females complained from postural kyphosis (diagnosed by orthopedist and confirmed by Formetric II instrument) selected from preparatory and secondary schools in Cairo and Giza

Governate shared in this study. Weight-Height Scale was used for measuring the body weight and height of each girl participating in the study to calculate the subject's body mass index. Their thoracic kyphosis angles were more than 40 degrees and less than 60 degrees. All patients were free from chest diseases, scoliosis and previous trauma to the spine, pelvis and lower limbs. All patients did not take any medications that might affect the neuromuscular functions at least three months before or during the study. The diagnosis of postural kyphosis was done for each patient by orthopedist before the beginning of the study and was confirmed by measuring thoracic kyphosis angle by Formetric II instrument. The study was conducted from January 2011 to March 2011. The evaluation by the Formetric II instrument in spinal shape analysis laboratory was at the Faculty of Physical Therapy, Cairo University, Fig. (1).



**Fig. (1): The scanning of the spine (Posterior view).**

The data had been collected and statistically analyzed by using descriptive statistics (mean, standard deviation and Pearson correlation coefficient).

## 3. Results

**A-** Physical characteristics of adolescence females. The ages of adolescence females ranged from (13-18) yrs, with a mean value of (15.43±1.70 yrs); their weight ranged from (50-59 kgs), with a mean value of (54.77±2.36 kgs), their height ranged from (148-163 cms), with a mean value of (154.80±3.69 cms), and their body mass index (BMI) ranged from (21.35 - 24.56 kg/m<sup>2</sup>), with a mean value of (22.86±0.87 kg/m<sup>2</sup>) (Table 1).

**Table 1:** Physical characteristics of adolescence females

Variables	Minimum	Maximum	Mean	Std. Deviation
Age (yrs.)	13.00	18.00	15.43	1.70
Weight (kg.)	50.00	59.00	54.77	2.36
Height (cm)	148.00	163.00	154.80	3.69
BMI (Kg/m <sup>2</sup> )	21.35	24.56	22.86	0.87

**Correlation between kyphotic angle (MAX) and trunk length of adolescence females**

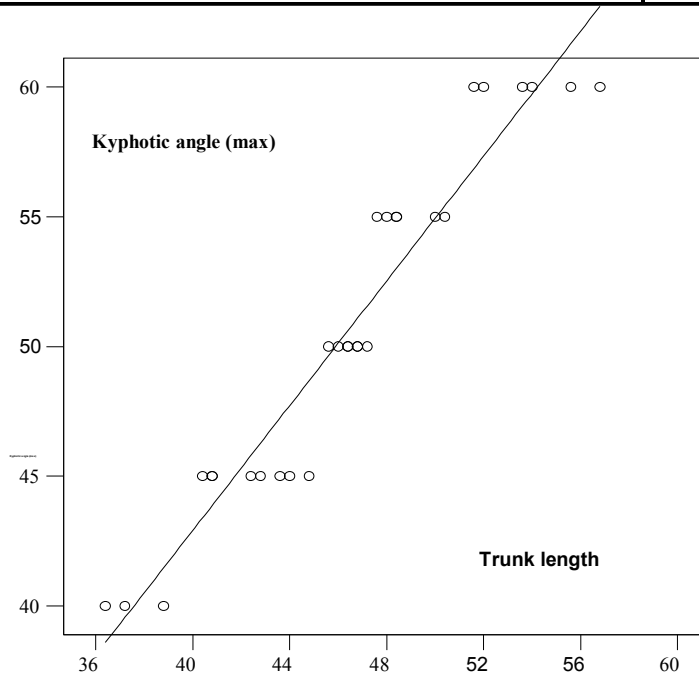
The thoracic kyphotic angle ranged between (41°-58°) degrees with a mean value of (52.12° ± 7.65°), while the trunk length ranged between

(36.2–54.6 cm) with a mean value of (45.13 ± 9.1 cm), (Table 2).

There was a strong positive correlation between kyphotic angle (MAX) and trunk length in adolescence female ( $r = 0.960$ ;  $p < 0.01$ ), (Fig. 2).

**Table 2:** Correlation between kyphotic angle (MAX) and trunk length of adolescence females

	Mean ± SD
Kyphotic angle (MAX)	52.12° ± 7.65°
Trunk length	45.13 ± 9.1 cm
Pearson correlation coefficient (r)	0.960
P value	< 0.01



**Fig. (2):** Correlation between kyphotic angle (MAX) and trunk length in adolescence.

**4. Discussion**

During adolescence, girls are prone to mechanical and societal influences that can lead to changes in postural alignment and the development of poor postural habits. Factors that contribute to increased thoracic kyphosis with subsequent loss of movement, protruding head position, and loss of shoulder range are induced by slouched sitting ill-fitting school desks, and overloaded bags and backpacks. Discomfort with changing body image, following growth spurts and body development, particularly breast changes, can further lead to shoulder protraction and thoracic joint stiffness

setting the stage for muscle imbalance and dysfunction later in life (Carbon, 1992).

Postural kyphosis may be caused by poor posture during adolescence; tall teen hunches forward around peers, or female teen hunches forward to conceal breast development. Chronic spasticity of pectoralis major and minor and serratus anterior muscles or weak rhomboid major and minor muscles can cause postural kyphosis (Susan, 2009).

Normal values for thoracic kyphosis are between 20° to 40° of angulations, when the curve of the spine exceeds this; it is described as either

postural kyphosis or Scheuermann's thoracic kyphosis (**Baker, 1988**).

The results of this study found that there was a strong positive correlation between thoracic kyphosis angle and trunk length ( $r= 0.960$ ;  $p < 0.01$ ) in adolescence females.

The result of this study agree with those of **Kendall and McCreary, (1993)** who found that adolescent postural kyphosis leads to increase in thoracic kyphosis and trunk length through the unnecessary tension that comes from the stretching of the para spinal muscles especially the erector spinae muscle and the elongation of the posterior longitudinal ligament, supraspinous and intraspinous ligaments of the thoracic spine. That was concluded by those authors in the study conducted in one of the preparatory school girls to determine the prevalence of postural kyphosis in middle aged adolescents by using the inclinometer as a way of measurement to the thoracic kyphotic angle.

The result of this study agreed with **Nissinen (1994)**, who found that slouching in sitting or standing was a common habit in girls after puberty which lead to postural kyphosis and lengthen the spinal ligaments beyond the normal limits which in turn will lead to increase trunk length in those girls.

The result of the current study are also supported by those of **Ashton and Schultz, (1997)**, **Nies and Kershaw, (2002)** and **Hawes (2006)**, who have found that following growth spurts and body development, particularly breasts development could increase thoracic kyphosis, trunk length, shift the centre of gravity away from the spine, and increase muscular effort required maintaining balance. Early education and training in body mechanics can help to form positive postural habits and help in developing and maintaining optimal muscle balance and skeletal alignment.

On the other hand, **Kado et al. (2007)** showed that there was no relationship between thoracic kyphosis and trunk length in postural kyphosis. As they examined the association between thoracic kyphosis and trunk length and other variables (Age, gender, body mass index, trunk inclination, lumbar lordosis and the inflection point of thoraco-lumbar region and lumbosacral region).

### Conclusion

On the basis of the data obtained in the present study, it can be concluded that there is a strong positive correlation between thoracic kyphosis angle and the trunk length in adolescence females ( $r= 0.960$ ;  $p < 0.01$ ).

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