Effect of Gender on Thoracic and Lumbar Vertebral Curvatures and Flexibility in Normal Subjects

Thesis

Submitted to Basic Science Department in Partial Fulfillment of Requirements for Master Degree in Physical Therapy

By

ABEER ABD EL-FTTAH ALI KHALEEL

B.Sc., in Physical Therapy (2002)

Supervisors

Ass. Prof. Dr. Ragia Mohamed Kamel

Assistant professor of Physical Therapy
Basic Science Department
Faculty of Physical Therapy
Cairo University

Dr. Neveen Abd El-Latif Abd El-Raoof

Lecturer of Physical Therapy
Basic Science Department
Faculty of Physical Therapy
Cairo University

Faculty of Physical Therapy

Cairo University

2009

تأثير نوع الجنس علي انحناءات و مرونة الفقرات الصدرية و القطنية في الأشخاص الطبيعيين

توطئة للحصول علي درجة الماجستير في العلاج الطبيعي

رسالة مقدمة لقسم العلوم الأساسية

عبير عبد الفتاح علي خليل

بكالوريوس العلاج الطبيعي ٢٠٠٢

هيئة الإشراف

أ.م .د / راجية محمد كامل

أستاذ مساعد العلاج الطبيعي،
قسم العلوم الأساسية،
كلية العلاج الطبيعي
جامعة القاهرة

د/ نيفين عبد اللطيف عبد الرؤوف

مدرس العلاج الطبيعي،
قسم العلوم الأساسية،
كلية العلاج الطبيعي،
جامعة القاهرة

كلية العلاج الطبيعى
جامعة القاهرة
٢٠٠٩

Acknowledgement

First of all, I would like to kneel thanking our **God** who provided me with essential power and patience for completing this work.

I wish to express my deepest gratitude to **Ass. Prof. Dr. Ragia Mohamed Kamel**, assistant professor of physical therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University for her kind supervision, and continuous generous guidance through the preparation and conduction of this work.

I am deeply grateful to my supervisor **Dr. Neveen Abd El-Latif**, lecturer of physical therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University for the interesting discussion, support, encouragement, useful advices and guidance and essential help in this study.

I would like to appreciate **Dr. Mohamed Abd El-Fatah**, Instructor of Orthopaedics and Musculoskeletal Disorders Department, Faculty of Physical Therapy, Cairo University, for his help during the practical part of this work.

Special thanks to my **professors** of basic science department for their encouragement and **colleagues** in the Faculty of Physical Therapy who helped me during the practical part of this work.

I owe my sincere thanks to **my family** for their love, continuous help, and their praying for my success.

Abstract

Effect of Gender on Thoracic and Lumbar Vertebral Curvatures and Flexibility in Normal Subjects. Abeer Abd EL-Fttah Ali Khaleel; Supervisors, Ass. Prof. Dr. Ragia Mohamed Kamel*, Dr. Neveen Abd El Latif Abd El Raoof*.

***Department of Basic Science, Faculty of Physical Therapy, Cairo University.Master Thesis; 2009.**

Background: Sagittal spinal curves and flexibility present a wide range for normal individuals within normal limits. **Purpose:** To investigate the effect of gender on thoracic and lumbar vertebral curvatures and flexibility in normal subjects. **Subjects**: 40 normal subjects from both genders participated in this study and assigned into two groups: Group (A) included 20 normal males with mean age of 21.45±2.15 years, weight 75.95±7.81 kg, height 177.3±7.56 cm, and BMI 23.56±1.038 kg/m² and Group (B) included 20 normal females with mean age of 21.65 years, weight 60.22±8.084 kg, height 159.9±6.86 cm, and BMI 23.45±1.308 kg/m². **Methods**: Assessment of thoracic and lumbar curvatures using the Formetric system was used to measure the lordotic angle and kyphotic angle, while the new noninvasive electronic device Spinal mouse was used to measure the thoracic and lumbar spine range of motion. **Results**: There were significant differences in the thoracic and lumbar curvatures between both genders P= 0.0132, 0.0039 respectively, and there was a significant difference in the lumbar flexibility between both genders P= 0.361 while there was no significant difference in thoracic flexibility between both genders P= 0.5352. **Conclusion:** This study concluded that normal females had higher thoracic and lumbar curvatures than normal males, also normal females had higher lumbar spine ROM than normal males while there was no significant difference between normal females had males regarding thoracic spine ROM.

Key words: Thoracic curvature, lumbar curvature, thoracic flexibility, lumbar flexibility, lordotic angle and kyphotic angle.

Introduction

The spinal column is a complex structure. When viewed in the frontal plane each vertebra gives the appearance of being stacked one upon the other. The view from the sagittal plane clearly demonstrates that the vertebrae, in the different regions of the cervical, thoracic, or lumbar spine, position themselves in a posture designated as lordosis or kyphosis. From a functional standpoint, the appropriate degree of lordosis or kyphosis in each segment of the spine creates a global posture and provides balance for our center of gravity (**Gallego and Manuel, 2001)**.

The vertebral spine presents regional curves on sagittal plane designed to absorb impact, reduce its longitudinal stiffness, and intensify muscular function **(Gelb et al.**, **1995).** These Physiological spinal curvatures occur as a result of the trapezoidal shape of vertebral bodies and inter vertebral discs. The thorathic spine, constituting about half the entire length of the vertebral column, is particularly vulnerable to the effects of gravity and torsion **(Kuslich, 2003).**

Normal thoracic kyphosis is in the range of 20° to 50°, there is a wide range of normal, which is made more difficult to interpret due to the variation in levels included. **(Gelb et al.**, **1995).**The lumbar spine in the healthy adults typically exhibit about 40 to 45 degree of lordosis **(Korovessis et al., 1998).** Lumbar lordosis has long been studied, and its curvature is associated with various factors, such as thoracic curvature, age, gender, pelvic bend, among others. Studies have been conducted intending to measure lumbar and spinal segments curvatures **(Jackson et al., 2000).**

Posture is the attitude which is assumed by body segments in relation to other to

maintain stability and balance with minimum effort and least strain during performing certain activity. Good posture is a state of muscular skeletal balance, which protects the supporting structures of the body against injury and progressive deformity; it can be maintained by adjusting the position of the head and limbs in relation to the trunk **(Grobowski, 2003).**

Spine is a complex structure consisting of a series of rigid elements (vertebrae) connected by flexible visco-elastic units (inter vertebral discs). Compressive, bending and shear loading can be transmitted by a combination of forces in the intervertebral discs, apophyseal facet joints, ligamentous structures and active muscle contraction. **(Gravis and Vasiliadis, 2006).**

The intervertebrat disc is subjected to stress whether a person is standing, walking or seated. In biological system the elastic properties of tissue are a time dependent function of the applied stress thus, loss of fluid takes place from the intervertebral disc space in response to static loading. **(Gravis and Vasiliadis, 2006).** Radiographic procedures have been used to evaluate the spine, although these only provide static two dimensional (2.D) images. A further disadvantage is that the patients are exposed to radiation. **(McGregor et al., 2001).**

Static radiographs have primarily been limited to measurements in the sagittal and frontal plane provided two dimensional representations of the three dimensional (3.D) motions, because actual spinal motion is 3.D and instability may include significant changes in motions. So the quantification of motion and diagnosis of segmental instability based only on plantar radiographs are inaccurate **(McGregor et al., 2001).**

The formetric system software generates a three-dimensional reconstruction of the form of spine and allows individual image analysis of the carried out

examinations depending on non contact and non ivasing manners and it analyzes all the existing curvatures without manual invasion and provide measuring values for comparison **(Liljenqvist et al., 1998).**

The spinal mouse is a computerized measurement device used to evaluate the spinal flexibility .It is a sophisticated electronic, measuring device designed to measure sagittal back shape and mobility**. (Mannion et al., 2004).**

Statement of the problem:

The present study was a trial to answer the following question:

Are there variations of spinal curvatures (kyphotic angle and lordotic angle] and spinal flexibility [thoracic spine range of motion and the lumbar spine range of motion) between normal males and females.

Purpose of the study:

This study was conducted to:

1. Investigate the effect of gender on the kyphotic angle.
2. Investigate the effect of gender on the lordotic angle.
3. Investigate the effect of gender on the thoracic spine range of motion.
4. Investigate the effect of gender on the lumbar spine range of motion.

Justification of the study:

The vertebral spine presents regional curves on sagittal plane designed to absorb impact, reduce its longitudinal stiffness, and intensify muscular function **(Gelb et al., 1995).**Values of sagittal curves measurements on spine present great variability in normal individuals, with a wide variation range for

those, within normality limits **(Stagnara et al., 1982).** Girls who participated in sports activities seem to experience more often disc prolapsed and low back pain than boys. Short children who carry backpacks as heavy as do tall children at the same age are more prone to low back pain **(Korovessis et al., 2001).**

Male adolescent idiopathic scoliosis patients had slightly more rigid primary curves compared to females but a similar degree of postoperative scoliosis correction. Differences in the preoperative status and preoperative course did not compromise the outcomes of surgical treatment as in all other measures; the results were comparable between the genders. **(Korovessis et al., 2001).**

Understanding the nature of spinal curvatures and flexibility improves the effectiveness of individual case management. Forces of gravity work through the interrelated linkages of the feet, knees, and legs into the spine and pelvis. These forces also influence the subject's ability to respond to and maintain adjustments. The body functions as a closed kinetic chain, where movement at one joint influences movement at other joints. **(Austin, 1994).**

There is an increasing awareness of the risks and dangers of exposure to radiation associated with repeated radiographic assessment of spinal curvature and spinal movements. As such, attempts are continuously being made to develop skin-surface devices like Spinal Mouse for use in examining the progression and response to treatment of various spinal disorders **(Liljenqvist., et al, 1998) .**

Formetric system is a method for back surface measurement comprising automatic back surface reconstruction and shape analysis. Formetric system is a reliable method in the three-dimensional evaluation of spinal deformities and constitutes a valuable additional tool to the clinical examination and can

reduce the number of radiographs **(Liljenqvist., et al, 1998) .**

Knowledge of normal ranges of spinal curvatures and flexibility in healthy subjects is lacking. It is not known if these ranges differ from normal men and women. So this study measured the normal ranges of spinal curvatures and flexibility in healthy subjects to put it as a reference for comparisons with any spine abnormality.

Delimitation:

The study was delimited to the following:

1. Forty normal subjects, (20 males and 20 females).
2. Age ranged from 18 to 25 years. **(Climet et al., 2005).**
3. The Body Mass Indexes of the subjects were within the normal range from 22 to 25 kg\m² **(Otuska et al., 2003).**
4. The formetric system was used for assessment of spinal curvatures.
5. The spinal mouse was used for assessment of spinal flexibility.
6. Standard medical weight and height scale was used for assessment of subjects′ weights and heights.
7. Data obtained were statistically analyzed using the unpaired t-test.
8. Level of significance was set at 0.05.

Limitation:

This study was limited by:

1. Unfamilarity of some subjects with the Formetric system.
2. Uncooperation of some subjects during the test**.**
3. The particular psycho-physiological condition of the subject at the time of measurements.

Basic assumption:

The following assumptions were necessarily made for the development of this study:

1. It was assumed that all subjects have the same psycho-physiological condition at the time of performance.
2. The instructions given to the subjects during assessment and measurement were accurately and faithfully followed.

Hypothesis:

It was hypothesized that:

1. There were no significant differences in the lordotic angle between normal males and females.
2. There were no significant differences in the kyphotic angle between normal males and females.
3. There were no significant differences in the thoracic spine ROM between normal males and females.
4. There were no significant differences in the lumbar spine ROM between normal males and females.

Definition of Terms:

Kyphosis: Abnormally increased convexity in the curvature of the thoracic spine as viewed from the side**. (Asher, 2007).**

Lordosis: The anterior concavity in the curvature of the lumbar and cervical spine as viewed from the side **(Asher, 2007).**

Scoliosis: Is a type of spinal curvature which is an appreciable lateral

deviation in the normally straight vertical line of the spine. **(Climet et al., 2005).**

Spinal Curvatures: Deviations of the spine from its normal direction or position. **(Oatis, 2005).**

Spinal Flexibility: The quality or state of being able to be bent or creased the spine repeatedly**. (Oatis, 2005).**

Contents

List of Tables