

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

Ragia Mohamed Kamel

Assistant professor of Physical Therapy

Basic Science Department

Faculty of Physical Therapy

Cairo University

Dr. Neveen Abd El-Latif Abd El-Raouf

Lecturer of Physical Therapy

Basic Science Department

Faculty of Physical Therapy

Cairo University

Faculty of Physical Therapy

Cairo University

2009

Abstract

Effect of Gender on Thoracic and Lumbar Vertebral Curvatures and Flexibility in Normal Subjects. Abeer Abd EL-Fttah Ali Khaleel; Supervisors, Ass. Prof. 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, height (177.3 ± 7.56) cm, weight (75.95 ± 7.81) kg, and BMI (23.56 ± 1.038) kg/m² and Group (B) included 20 normal females with mean age of (21.65 ± 2.48) years, height (159.9 ± 6.86) cm, weight (60.22 ± 8.084) kg, , 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.

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.

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.

Contents

CHAPTER	page
I-Introduction.....	1
• Statement of the problem.....	3
• Purpose of the study.....	3
• Justification of the study.....	4
• Delimitation	5
• Limitation.....	5
• Basic assumption.....	6
• Hypothesis.....	6
• Definition of Terms.....	6
II-Literature Review.....	8
• Embryological origin of the vertebral column.....	8
• Anatomy of the spine.....	15
• Biomechanics of spine.....	21
• Abnormal spine.....	24
• Spinal curvatures.....	28
• Assessment of spinal curvatures.....	38
• Assessment of spinal flexibility:.....	46
III-Materials and Methods.....	54
• Selection of the subjects.....	54
• Design of the study	55
• Instrumentation.....	55
• Procedures of the measurement.....	58

• Data collection.....	64
• Statistical analysis.....	65
IV- Analysis Of Results.....	66
• General Characteristics of the subjects.....	66
• The mean values and standard deviation of the lordotic angle and kyphotic angle were recorded for each subject in both groups.....	70
• The unpaired t-test was used to identify the differences between both groups concerning the lordotic angle and the kyphotic angle values	72
• The mean values and standard deviation of the thoracic spine ROM and lumbar spine ROM were recorded for each subject in both groups.....	73
• The unpaired t-test was used to identify the differences between both groups concerning the thoracic spine ROM and lumbar spine ROM values.....	75
V-Discussion.....	76
VI- Summary and conclusion summary.....	84
• summary	84
• Findings.....	85
• Conclusions.....	85
• Implementations.....	86
• Recommendations.....	86

References.....	88
------------------------	-----------

Appendices

Arabic summary

List of Tables

Figure	Title	Page
(2-1)	Pairs of Somites	9
(4-1)	Physical characteristics of subjects in both groups	67
(4-2)	The mean and standard deviation of the Lodotic Angle and Kyphotic Angle of group A (the men group)	70
(4-3)	The mean and standard deviation of the Lodotic Angle and Kyphotic Angle of group B (the women group)	70
(4-4)	The results of the independent t-test between both groups regarding the Lodotic Angle and the Kyphotic Angle	72
(4-5)	The mean and standard deviation of the Thoracic Spine range of motion and the Lumbar Spine range of motion of group A (the men group)	73
(4-6)	The mean and standard deviation of the Thoracic Spine range of motion and the Lumbar Spine range of motion of group B (the women group)	73
(4-7)	The results of the independent t-test between both groups regarding the Thoracic Spine range of motion and the Lumbar Spine range of motion	75
(5-1)	Testing of hypothesis	83

List of Figures

Figure	Title	Page
(2-1)	Embryological development of the neural cord and musculoskeletal system	9
(2-2)	Structure of vertebral column	15
(2-3)	Characteristics of a typical vertebra	16
(2-4)	Intervertebral disc	17
(2-5)	Spinal ligaments	18
(2-6)	Deep back muscles	20
(2-7)	Normal Spinal Segment	23
(2-8)	Scoliosis	25
(2-9)	Kyphosis	27
(2-10)	Spinal Curvatures	29
(2-11)	Development of spinal curvatures	30
(2-12)	Thoracic vertebrae shape	33
(2-13)	Thoracic kyphosis	33
(2-14)	Lumbar Spine	35
(2-15)	Hyper lordosis	37
(2-16)	Flexible Ruler	39
(2-17)	Assessment by flexible Ruler	39
(2-18)	Cobb's Angle	40
(2-19)	Scoliometer	41
(2-20)	Assessment of thoracic kyphosis by DeBrunner kyphometer	42
(2-21)	Assessment of lumbar lordosis by the modified kyphometer	43
(2-22)	Modified Schober Test	47
(2-23)	Fingertip-to-floor Test	48
(2-24)	The Inclinator	49
(3-1)	Formetric system in the Formetric Laboratory.	56
(3-2)	Spinal mouse	58
(3-3)	Subject and system positioning	59

Figure	Title	Page
(3-4)	Anatomical landmarks	61
(3-5)	Spinal mouse and subject positioning in Erect position	62
(3-6)	Spinal mouse and subject positioning in maximal flexion position	63
(3-7)	Spinal mouse and subject positioning in maximal extension position	64
(4-1)	The mean of age for group A and B	68
(4-2)	The mean of height for group A and B	68
(4-3)	The mean of weight for group A and B	69
(4-4)	The mean of Body Mass Index (BMI) for group A and B	69
(4-5)	The mean of Lodotic Angle in group A and B	71
(4-6)	The mean of Kyphotic Angle in group A and B	71
(4-7)	The mean of Thoracic Spine range of motion in group A and B	74
(4-8)	The mean of the Lumbar Spine range of motion in group A and B	74

List of Abbreviations

BMI: Body Mass Index

Fig: Figure

ROM: Range of Motion

2D: Two dimensions

3D: Three dimensions