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Original Research Article

EFFECT OF BODY MASS INDEX, CENTRAL OBESITY AND CORE MUSCLE ACTIVATION ON PELVIC INCLINATION AND LUMBOSACRAL ANGLE IN INDIVIDUALS WITH LOW BACK PAIN: AN OBSERVATIONAL STUDY

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ABSTRACT

Background: Obesity is an increasing problem of epidemic proportion, and is associated with various musculoskeletal disorders, including impairment of spine [1]. Obesity is a condition of accumulation of excessive fat in adipose tissues which leads to sever health issues. Low back pain is a leading cause of disability [2]. It can be due to specific or non specific causes. The lumbar spine in obese individuals becomes hyperlordotic, which is a risk factor for low back pain and poor posture.

Purpose: To assess the effect of body mass index, central obesity and core muscle activation on the spino-pelvic parameters in individuals with low back pain.

Study Design: Prospective Correlation Study.

Materials and Methods: An observational study with 30 participants was conducted. Parameters measured were angle of pelvic inclination, lumbosacral angle, core muscle activation using a pressure biofeedback and low back pain was assessed using modified oswestry back pain disability questionnaire. Subjects were classified based on BMI i.e. $\geq$ 24.BMI was calculated according to the formula weight(kgs) divided with height(mts)^2.

Result: The results showed significance in central obesity based on gender with a p value 0.0005. Core muscle activation level showed a negative t value. Correlation between pelvic inclination and BMI found to be significant with a p-value of 0.0043, with lumbosacral angle 0.0370 and core muscle activation 0.0177.

Conclusion: Individuals with low back pain showed higher degree of pelvic inclination angle and lumbosacral angle, with a reduced core muscle activation.

KEY WORDS: Body mass index, Central obesity, Low back Pain, Pelvic inclination, Lumbosacral Angle, Core muscle activation.

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INTRODUCTION

Obesity is an increasing problem of epidemic proportion, and is associated with various musculoskeletal disorders, including impairment of spine [1].) Obesity is a condition of accumulation of excessive fat in adipose tissues which leads to sever health issues. Low back pain is a leading cause of disability. It occurs in similar proportions in all cultures, interferes with quality of life and work performance, and is the most common reason for medical consultations [2]. Back pain can be due to specific or non-specific cause. Most of the cases seen are non- specific. Pelvis bears weight of the upper body. Anterior and posterior tilts, which are motion of the entire pelvic ring in the sagittal plane around the coronal axis, depends on the lumbar spine [3]. In normally aligned pelvis, the anterior superior iliac spine (ASIS) of the pelvis lie on a horizontal line with the posterior superior iliac spine (PSIS) and on the vertical line with the symphysis pubis [4].

Posture plays an important role as, faulty posture leads to back pain. When spine becomes displaced and unbalanced, a greater number of muscles fibers are called into play at more frequent intervals to keep the spine straight, thus fatigue results of which the spine sags putting the strain on the ligaments and post articulating facets. This occurs changes at the facet joints and lumbosacral junction [5].

Core muscles provide spinal stability which is necessary for activities of daily living [6]. Pressure Biofeedback is clinically used to control, activate and train the core musculature. They are inelastic units usually inflated when the inter-pressure increases [7].

Multiple studies have described normative values for parameters of spino-pelvic alignment in different population of varying ages, and pathologic conditions [8,9].

The current study was designed to assess the effect of BMI, central obesity and core muscle activation on the pelvic inclination and lumbosacral angle in low back pain individuals and to determine if there is a correlation between the parameters so that it provides a better understanding of this relationship.

MATERIAL AND METHODS

A cross sectional study was conducted. The sample consisted of 30 young adult with low back pain who were recruited in the study with their BMI ≥24kg/mts^2. There were 10 males and 20 females in the study. Subjects with any previous history of spine surgery, pregnant females, radiating pain, trauma and individuals with BMI <18.5kg/mts^2 were excluded from the study. For each subject the following information was obtained: Age, Sex, BMI, central obesity, Pelvic inclination and lumbosacral angle and the level of core muscle activation. BMI was calculated by dividing weight (kg) and height (metes)^2.Lumbosacral angle was measured with flexicurve ruler. Subjects were taken to examination and were asked to expose lumbar spine. With the help of the marker the examiner located 2 spinal landmarks (S_2 and T_{12}/L_1). The flexible ruler was placed on the spinous process of the lumbar spine of the subject in standing position, the instrument then was carefully removed and placed on the graph sheet. A vertical line was drawn to connect T_{12} and S_2 landmarks. Length of the lumbar curvaturewas measured incentimeters.The following is the equation

$$[\partial] = 4 \text{ X } [\text{arc tan } (2H/L)]$$

Where- = Magnitude of lordotic curve

L= Length of lumbar curve

H= Deepest part of the curve.

Pelvic inclination was measured with pelvic inclinometer with patient in standing position. The two stable arm of inclinometer were placed at the iliac crest and with the help of bubble they were aligned in neutral and then the degree was measured.

Core muscle activation was measured with patient in crook lying position on a plinth with knee 90°. Pressure cuff was placed across the lumbar spine (base at S2) and was inflated to 40 mmHg. The subject was asked to maintain steady pressure as possible and the subject was asked to perform draw-in maneuver (tummy tuck). The examiner then increased the pressure and the subject was advised to maintain the steady pressure throughout the test. Then the level at which the subject maintains constant pressure for 10 sec was noted by the investigator, and then it was graded, according to Sahrmann Core Stability Test.

Statistical Analysis: Various statistical measures such as mean, standard deviation and test of significance such as student paired 't' test was used to verify the normal data. Karl Pearson's Correlation Coefficient was used to analyze the correlation between various parameters. Statistical significance levels were considered to be $P < 0.05$.

RESULTS

The number of participants was 30 (n=30) with a BMI of $\geq$24kg/mts^2. The statistical analysis revealed significant correlation between BMI and pelvic inclination (P= 0.0043).

Table1: Correlation between Pelvic inclination (in degrees) with other variables by Karl Pearson's correlation coefficient method.

Variables	Pelvic Inclination Angle (in degrees)		
	r-value	t-value	p-value
Lumbosacral Angle (radians)	0.3824	2.1901	0.0370*
Core muscle activation	-0.43	-2.5199	0.0177*

*p<0.05

The correlation between pelvic inclination and lumbosacral angle was good (P= 0.0370). Core muscle activation revealed a negative significance as shown.

Graph 1: Graphical Representation of Correlation between Pelvic inclination (in degrees) with other variables by Karl Pearson's correlation coefficient method.

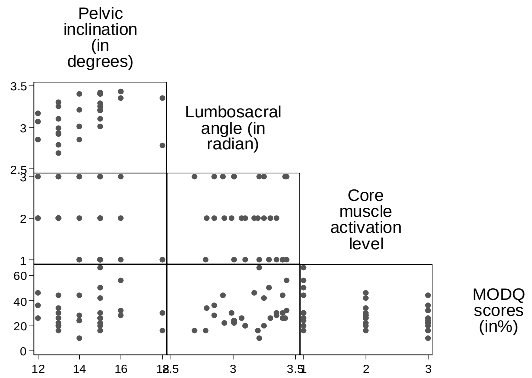


Table 2: Correlation between BMI with other variables by Karl Pearson's correlation.

Variables	Correlation between BMI with		
	r-value	t-value	p-value
Central obesity	0.1365	0.7292	0.4719
Pelvic inclination (in degrees)	0.5062	3.1063	0.0043*
Lumbosacral angle (in radian)	0.1967	1.0614	0.2976
Core muscle activation level	-0.2763	-1.5211	0.1395
MODQ scores (%)	0.0105	0.0555	0.9561

*p<0.05

Correlation between BMI and Pelvic inclination angle was good with (P=0.0043)

Graph 2: Graphical representation of Correlation between BMI with other variables by Karl Pearson's correlation.

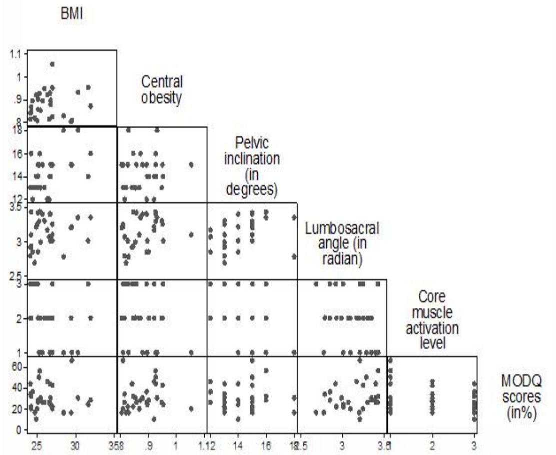


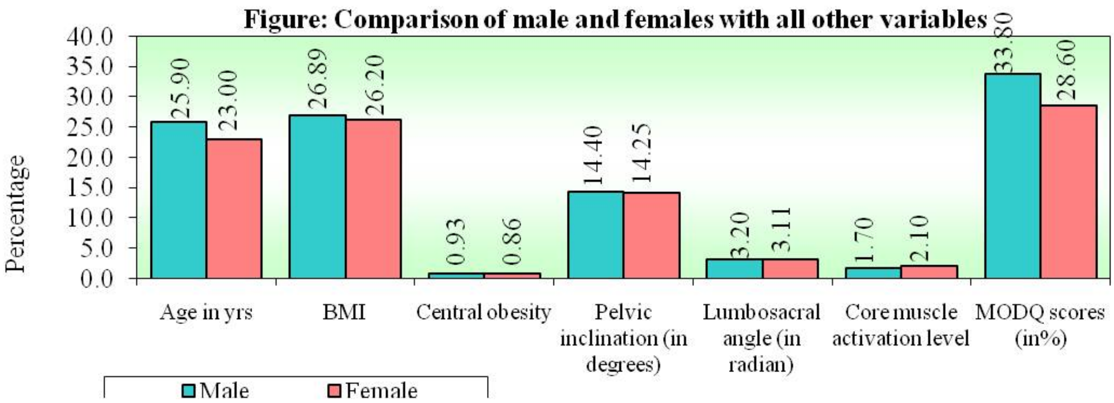
Table 3: Comparison of male and females with all other variables by t test.

Variable	Gender	N	Mean	SD	t-value	P-value
Age in yrs	M	10	25.9	5.55	1.679	0.1043
	F	20	23	3.84		
BMI	M	10	26.89	2.68	0.8041	0.4281
	F	20	26.2	1.96		
Central obesity	M	10	0.93	0.05	3.967	0.0005*
	F	20	0.86	0.05		
Pelvic inclination (in degrees)	M	10	14.4	1.26	0.2447	0.8085
	F	20	14.25	1.71		
Lumbosacral angle (in radian)	M	10	3.2	0.23	1.0397	0.3074
	F	20	3.11	0.22		
Core muscle activation level	M	10	1.7	0.82	-1.2917	0.207
	F	20	2.1	0.79		

*p<0.05

The mean value and SD for the measured parameters are shown.

Graph 3: Showing the Comparison of Male and Females with all other variables.



DISCUSSION

Spinal curvature plays an important role in increasing elasticity against axial compression, and in keeping balance of body weight axis [10]. Curvature of sagittal plane depends on not only articular surface but many other factors such as Para spinal muscle tone, balance of agonist and antagonist muscles, habit of posture, fatigue and so on [11,12]. Change of lumbar lordosis causes overloading on facet joint and intervertebral disc. In addition, nerve root compression, muscle contracture, degenerative change, and ligament injury can follow it [13,14].

Normally the spine resists axial load and anterior shear forces at the lumbosacral junction. In obese individuals it may lead to a greater shear loads and hence makes the lumbosacral junction less stable [15]. The present study provides an objective analysis of correlation between BMI, central obesity and all the parameters such as pelvic inclination angle, lumbosacral angle and core muscle activation. The finding in this study revealed that there was a significant difference in central obesity when compared to gender. Body mass index showed significant correlation with pelvic inclination angle. When correlating core muscle with other parameters, observed a negative correlation. This finding implies that there is weak core muscle activation in individuals with low back pain which in turn leads to an increase in lumbosacral and pelvic inclination angle.

There have been several investigations that concluded during stance, obese patients showed hyperextension of lumbar spine [8,15]. Therefore, the present study states that elevated abdominal circumference i.e. central obesity has an effect on the spinal parameter. A good correlation was noted with the BMI, central obesity and the spine pelvic parameters.

According to the differences observed, it is recognized that the association between BMI, central obesity the spinal parameters with the spinal parameters is good. Positively a larger sample size with increased (BMI 35-39.9), Class II obesity (BMI $\geq$ 40) and Class III obesity should provide an interesting correlation.

CONCLUSION

Increase in BMI causes increase in pelvic inclination angle and reduces the core muscle activation which leads to low back pain in younger individuals.

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Conflicts of interest: None

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