RELATIONSHIP BETWEEN SEVERITY OF STRESS URINARY INCONTINENCE AND SAGITTAL LUMBOPELVIC ALIGNMENT IN FEMALES

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Abstract

Background: Stress urinary incontinence (SUI) is one of the pelvic floor dysfunctions that affecting the females in the middle age. The lumbo-pelvic position may affect the activity of the pelvic floor muscles, which play a primary role in the maintenance of continence and support of the abdominal contents.

Aim: The objective of this study was to investigate the association between the severity of stress incontinence and the lumbo-pelvic alignment in females with SUI.

Design: cross-sectional study

Material and methods: Twenty-eight married females aged from 20-50 years old with stress urinary incontinence were included in this study. The severity of the SUI was determined by using the incontinence severity index (ISI). The lumbopelvic alignment was measured by using lateral standing radiograph of the lumbopelvic spine then the measurement was carried out by using surgimap spine software. The parameters measured include lumbar lordosis, sacral slope, and pelvic tilt. A Spearman's rank-order correlation was run to assess the relationship between incontinence severity index and lumbar lordosis, sacral slop and pelvic tilt. The alpha level was set at 0.05.

Results: it was seen that the increase in the incontinence severity index is consistent with an increase in lumbar lordosis sacral slop while the pelvic tilt showed no change ($P < 0.05$).There was a positive correlation between severity of stress incontinence lumbar lordosis ($p=0.008$) and sacral slope ($p=0.013$).

Conclusion: Females who report SUI have an association between severity of SUI with lumbar lordosis, sacral slope and the sagittal spinal alignment. These finding should be taken into consideration in females have SUI.

Keywords: Sagittallumbopelvic alignment, Stress urinary incontinence.

Introduction

Urinary incontinence is a common pelvic floor dysfunctions that cause a social or hygiene problem **(1)**. The prevalence of incontinence, in general, is about 51% **(2)**. Stress urinary incontinence (SUI) is the most common form of urinary incontinence affecting the females in the middle age, is described as the complaint of involuntary loss of urine on effort or physical exertion (e.g. sporting activities), or on sneezing or coughing**(1)**.

The pelvic floor muscles (PFMs) forming the base of the abdominal cavity, play a primary role in maintenance of continence and support of the abdominal contents **(3)**, it also play an additional role in assisting in ventilation, postural control **(4)**, and along with the multifidus, transversusabdominis, and diaphragm play important roles in motor control, providing dynamic stability of the lumbopelvic area **(5, 6)**. Previous studies have been found that there is delayed activation in PFMs and trunk muscles in a patient with lumbopelvic dysfunction in association withSUI **(5, 6).**

The normal curvatures of the spine protect the PFMs from the extra increase of the intraabdominal pressure allowing the effective function of them **(7).**The position of the lumbar spine during standing and sitting posture can affect the activity of PFMs. **Sapsford et al. (2008)** found that greater activity of PFMs was recorded during upright unsupported sitting posture compared to slumped supported sitting **(8).Capson et al. (2011) and Ptaszkowski et al. (2017)** found that during standing posture greater activity of PFMs was recorded in hyperlordotic position. These results show that the spinal alignment can affect the activity and normal function of PFMs **(9, 10).**

Capson et al. (2011) stated that the Lumbo-pelvic posture can influence the ability of the pelvic floor muscles to contract effectively and this explain the epidemiological link between lumbo-pelvic dysfunction and urinary incontinence **(9).**

Few studies demonstrated that the associations between SUI and pelvic pain and low back pain with the majority of patients with low back pain had pelvic floor dysfunctions **(9, 10).** However; there is no evidence on the effect of PFMs weakness on the changes on the lumbopelvic alignment. The aim of study was to investigate the association between the severity of stress incontinence and the lumbo-pelvic alignment in females with SUI.

Subject, materials and methods

Design: The study was a cross-sectional study.

This study was conducted at the department of gynecology and obstetrics, Kaser El Aini teaching hospital. The study extended from May 2018 to January 2019.

Subjects:

A total of 36 patients were assessed for eligibility criteria. From them, 8 patients were excluded. Patients were excluded because they did not meet the inclusion criteria (n=5), refused to participate (n=3). A total of 28 participants entered the study with a range of age (20-50 years). Patients were consecutively recruited from those referred by a physician for physiotherapy because of SUI (**figure 1**).

The sample size was defined based on an 80% predicted power and an alpha of 0.05 with r= 0.5. The value of (r) was determined based on a pilot study (10 patients), which evaluated the relationship between SUI severity and lumbar lordosis. Calculations were performed using G*power software (Franz Faul, University of Kiel, Germany), and a sample size of at least 26 women were identified.

Inclusion and Exclusion Criteria:

Patients included in the study were required to have stress urinary incontinence for more than 6 months with BMI 20 – 30 Kg\m^2. Patients were excluded if they reported any of the following conditions: Pregnant females, females with BMI> 30 kg\m^2, who received physiotherapy treatment for incontinence in the past year, female patients with previous spinal, pelvic floor or abdominal surgery, recent childbirth, and pelvic organ prolapse grade 3 or 4.

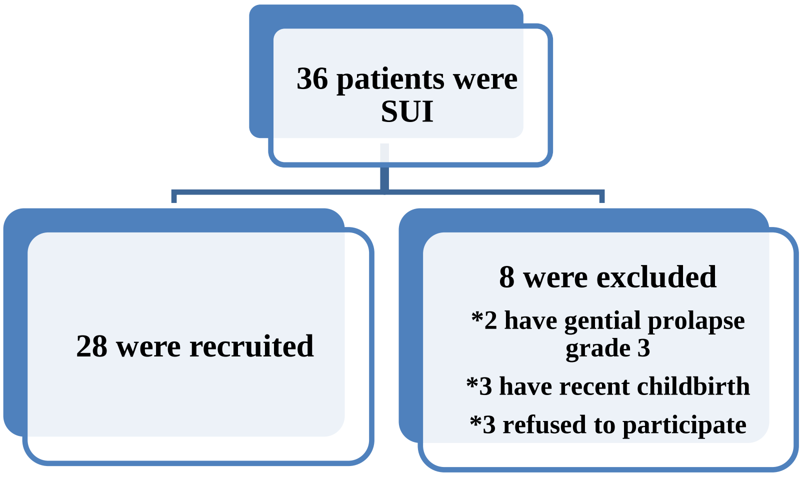

Figure 1: Participants flow diagram

Procedures:

Demographic data were collected from all subjects regarding age, weight, height, and BMI. Participants have signed informed consent after being familiarized with the objectives, procedures of the study, privacy use of data. This study was approved by the Research Ethical Committee of the Faculty of Physical Therapy, Cairo University, Egypt No: P.T. REC/012/001957 - 6/5/2018.

1. **The degree of severity of stress urinary incontinence:**

After taking the history and the patient was diagnosed as SUI the degree of the severity of symptoms was determined by incontinence severity index (ISI) asking the patient about the frequency of symptoms and amount of leakage of urine at each time. With this instrument the degree of severity was rated into 3 or 4 grades: 1-2 = mild, 3-6= moderate, 8-9= severe and 12= very sever. The ISI is a valid and reliable instrument **(11).** This study included patients with mild and moderate degrees of SUI.

2. **Measurement of lumbopelvic parameters:**

To assess the lumbopelvic parameters a lateral standing radiograph of the lumbopelvic area were obtained (**Figure 2**). The patients were instructed to stand in a comfortable position with the hips and knees were fully extended. The arms were crossed over the chest. All radiographs then were entered to a computer in a digital form. After that, the parameters of the sagittal alignment of the lumbopelvic area were measured by using surgimap spine software (Spine Software, version 2.2.15, 4, NY). Three radiographic parameters including; lumbar lordosis (LL), sacral slope (SS) and pelvic tilt (PT) were measured for each patient with the LL was defined as the angle between the superior sacral end plate and the superior endplate of the first lumbar vertebrae, SS was defined as the angle between the horizontal line and the superior sacral end-plate and PT was defined as the angle between the vertical line and the line joining the middle of the sacral plate and the center of the bicoxofemoral axis (the line between the geometric centers of both femoral heads) **(12).**

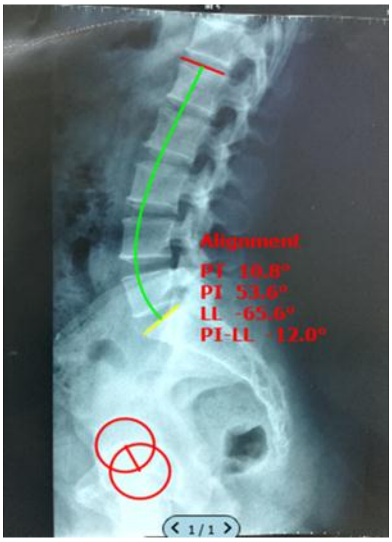

Figure2:Lumbo-pelvic parameters

Statistical Analysis:

Descriptive statistics (mean and standard deviation) were conducted for mean age, weight, height, BMI. Normal distribution of data was checked using the Shapiro-Wilk test for all variables.

Statistical analysis was conducted using SPSS for Windows, version 23 (SPSS, Inc., Chicago, IL). The current test involved three continuous dependent variables (lumbar lordosis, sacral slope and pelvic tilt) and one ordinal variable (incontinence severity index). A Spearman's rank-order correlation was run to assess the relationship between incontinence severity index and lumbar lordosis, sacral slope and pelvic tilt. An overall P-value was set at 0.05 considered to show a statistically significant result.

Results

Twenty-eight subjects with SUI their mean age, body mass, height, BMI values were 33±6.6 years, 74.8±9.9 Kg, 162.79±6.3 cm, and 28±2.76 Kg/m2 respectively.

1- Correlation of mean value of incontinence severity index and lumbar lordosis:

Spearman's rank-order correlation (ρ) between the mean value of the incontinence severity index and lumbar lordosis was 0.494. The results indicated that there was a positive weak correlation (p=0.008*). This means that an increase in the incontinence severity index is consistent with an increase in lumbar lordosis**(table 1 and fig3).**

Table (1): Correlations between the incontinence severity index and lumbar lordosis.

	Incontinence severity index	Lumbar lordosis
Mean±SD	3.57±1.83	63.7±9.19
ρ	**0.494**	
p-value	**0.008***	

ρ: Spearman's rank-order correlation, *Significant: P <0.05.

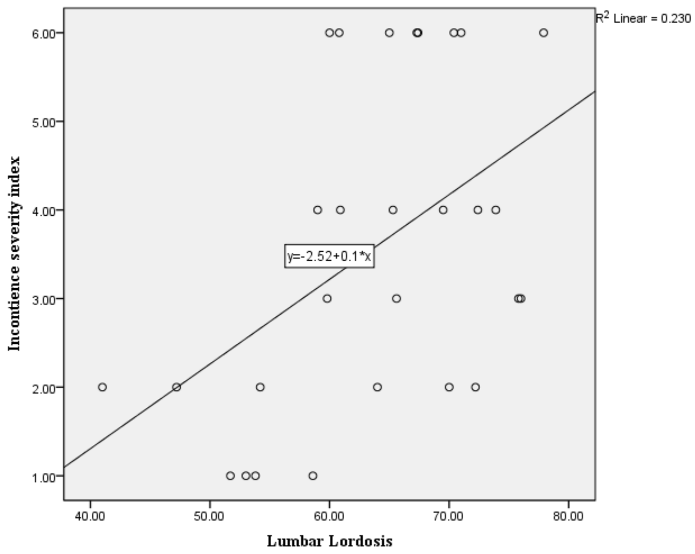

Figure (3). Scatter plot for the bivariate correlation between the incontinence severity index and lumbar lordosis.

2- Correlation of mean value of incontinence severity index and sacral slope:

Spearman's rank-order correlation (ρ) between the mean value of the incontinence severity index and sacral slope was 0.465. The results indicated that there was a positive weak correlation (p=0.013*). This means that an increase in the incontinence severity index is consistent with an increase in sacral slope**(table2 and fig 4).**

Table (2): Correlations between the incontinence severity index and sacral slope.

	Incontinence severity index	**Sacral slope**
Mean±SD	3.57±1.83	38.38±7.27
ρ	**0.465**	
p-value	**0.013***	

ρ: Spearman's rank-order correlation, *Significant: P <0.05.

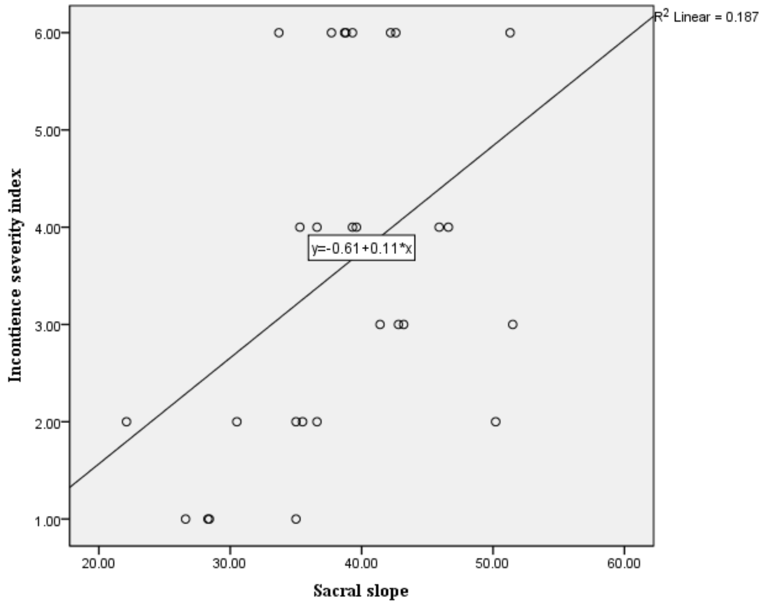

Figure (4). Scatter plot for the bivariate correlation between the incontinence severity index and sacral slop.

3- Correlation of mean value of incontinence severity index and pelvic tilt:

Spearman's rank-order correlation (ρ) between the mean value of incontinence severity index and pelvic tilt was -0.161. The results indicated that there was no correlation (p=0.414). This means that change in the incontinence severity index is not consistent with a change in pelvic tilt**(table 3 and fig5).**

Table (3): Correlations betweenthe incontinence severity index and pelvic tilt.

	Incontinence severity index	Pelvic tilt
Mean±SD	3.57±1.83	17.65±8.12
ρ	**-0.161**	
p-value	**0.414**	

ρ: Spearman's rank-order correlation, *Significant: P <0.05.

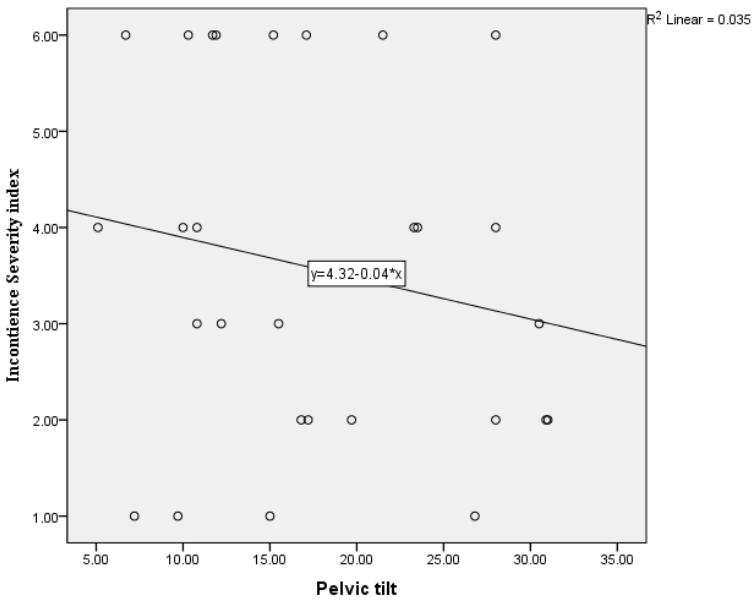

Figure (5). Scatter plot for the bivariate correlation between the incontinence severity index and pelvic tilt.

Discussion

The main purpose of this study was to investigate the association between severity of stress urinary incontinence and the sagittal lumbopelvic alignment in middle-aged females.

The study hypothesis stated that there would be no association between severity of stress urinary incontinence and the sagittal lumbopelvic alignment in middle-aged females. Based on The results of a present study this hypothesis is rejected as there was association between severity of stress urinary incontinence and the sagittal lumbopelvic alignment (lumbar lordosis and sacral slope).

The findings of current study are supported by work of **Pool-Goudzwaard et al. (2004) (13)**who studied the effect of pelvic floor muscles contractions in cadavers. They found that simulated tension in the pelvic floor muscles as a group can control the movement of the sacrum causing backward rotation of it so decreasing sacral slope hence decreasing the lumbar lordosis**.**

The result of present study is also supported by work of **Capson et al. (2011) and Ptaszkowski et al. (2017)(9, 10)**who investigated the effect of changing of lumbar lordosis and pelvic inclination on the activity of PFMs. They found that there was a higher activity of the PFMs in the position of hypolordosis and posterior pelvic tilting in relation to other positions.

The result of this study is also supported by study of **Zhoolideh et al. (2017)(14)** that reported the association between the postural changes and pelvic floor dysfunctions

(PFDs) and concluded that postural changes can be seen more often in women with PFDs**.**

Several studies demonstrated the associations between the SUI and the LBP , the results of this study can explain one of the aspects of these associations that the weakness of the PFMs causes changing in the lumbopelvic alignment that may cause the LBP **(15-21).**

The result of current study disagrees with the work of **El-Shamy and Moharm. (2013) (22)** that studied the effect of pelvic posture on the activity of PFMs in SUI and concluded that posterior pelvic tilt is not a good position to increase PFM contraction compared to anterior pelvic tilt and normal pelvic tilt.

The pelvic floor muscles form the base of the abdominal and pelvic cavities. Due to their positions, they have a fundamental role in maintaining the continence through adding stiffness in the supportive layer of the urethra, stabilization of the bladder neck and increasing intra ureteral pressure against the external pressure **(18).** The role of the PFMs were not limited to this only, they provide mechanical support to the spine and pelvis. This latter role is achieved via a contribution to stiffness of the sacroiliac joint **(13)** and via modulation of intra-abdominal pressure which is important for control of the spine **(23),** the PFMs have dual functions continence and postural one.

Hodges et al. (2007)(24).studied the activity of PFMs during single and repetitive arm movements that challenge the stability of the spine. They found that PFM contributes to the postural response associated with arm movements because the muscles are active as a component of the preprogrammed postural adjustment that prepares the body for predictable perturbations. Furthermore, PFM activity is associated with the activity of the abdominal muscles than with changes in IAP.

These dual functions of the PF muscles are related and loss of one of these functions due to a weakness of the PF muscles or delayed activation can compromise the others. As In SUI there is delayed activation and weakness of PFM compared with continent women **(25-27).** This delayed activity in women with SUI affect the postural activity during arm movement that lead to affection of the lumbopelvic stability and place the spine and pelvis at risk of injury **(18).**this can explain the result of our study that increase in the severity of SUI compromise the maintain of sagittal alignment of spine.

It is well accepted that the activity of the trunk muscles that produce the intra-abdominal pressure is important in spinal stabilization **(28).** On studying the effect of imbalance of trunk muscles on the spinopelvic alignment it has been found that the imbalance of trunk muscles causes excessive lordosis which is a major reason for chronic LBP **(29).**

The pelvic floor muscles and abdominal muscles are related functionally to each other, both muscles contribute to the intraabdominal pressure that is important in spinal stability. Also, the contraction of abdominal muscles increases the activity of PFMs as proved by **Sapsford and Hodges (2001) (30).** In addition to this because the abdominal muscles originate from the iliac crest and symphysis of the pubis and inserts on the xiphoid process and cartilages of five to seven ribs, it can tilt the pelvis posteriorly and decrease the curvature of the lumbar spine **(31).** It has been found that the activity of PFMs is increased in the in the hypo-lordotic posture as compared to the normal and hyperlordotic postures **(9).**

Several studies have shown a strong association between back pain and UI **(15-21).** Although **Mohseni-Bandpei et al (2011)(32)** reported that the PFM exercise combined with routine treatment was not more effective in treatment alone in patients with chronic LBP. **Kaptan et al. (2016)(33)** studied the association between UI, LBP with radiculopathy in women. They found that there is no correlation between lumbosacral pathologies and SUI. Despite the strong association, no evidence can define the causes of this association.

Mattox et al. (2000) and Melli and Alizadeh (2007) (34,35) studied the spinal curvature as a risk factor for pelvic floor dysfunctions and found that abnormal spinal curvature that represents excessive thoracic kyphosis and decreased lumbar lordosis is associated with higher pelvic floor dysfunctions.

While **Meyer et al. (2016) (36)**showed no association between pelvic floor symptoms and thoracic or lumbar spine angles and no statistically significant differences in the mean thoracic and lumbar curvature angles between women with and without pelvic floor symptoms**.**

The result of present study may be due to changing in normal spinal curves that cause extra intra-abdominal pressure on to the pelvic floor. This increase of the forward curves of lumbar in case of pelvic floor dysfunction might help in supporting abdominal viscera and absorbing downward intra-abdominal pressure before it reaches pelvic region.

- **Conclusion:**

Female who report SUI have an association between severity of SUI with lumbar lordosis, sacral slope and the sagittal spinal alignment. Theses finding should be taken into consideration in females have SUI especially who have LBP.

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