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SPINAL AND PELVIC DISPOSITION ASSOCIATED WITH UTERO-VAGINAL PROLAPSE AMONG POST-MENOPAUSAL WOMEN IN CHENNAI (SOUTH INDIA)-A SINGLE BLINDED PILOT STUDY

[1]Deepthi Ganesan, [2]Yu Chye Wah, [3]Lavanya Prathap, [4]Pandian Sankara kumaran, [5]Kshtrashal Singh [6]Prathap Suganthirababu, [7]Vinodh Kumar Ramalingam

[1,4,5]Lecturer, School of physiotherapy, AIMST University, Malaysia

[2]Associate professor, Dean, Faculty of allied health sciences, AIMST University, Malaysia.

[3]Assistant professor, Department of anatomy, Saveetha Dental College and Hospital, Chennai, India.

[6]Professor, Saveetha College of physiotherapy, SIMATS, Chennai, India.

[7]Senior Lecturer, Department of physiotherapy, Faculty of health and life sciences, INTI International University, Malaysia.

Corresponding author

[7]Vinodhkumar Ramalingam, Senior Lecturer, Department of physiotherapy, Faculty of health and life sciences, INTI International University, Malaysia.

vinodh.ramalingam@newinti.edu.my, vino_hai79@yahoo.co.in

ABSTRACT:

Background: Levatorani muscle and pelvic connective tissues provide primary support to the pelvic organs. Women are predisposed to pelvic organ prolapse due to the weakness of pelvic floor muscles and ligament laxity, which is mostly associated with aging and an increase in intra-abdominal pressure that affects the biomechanical properties of the pelvic tissues. Hence, this study aims to find the correlation between the spinal and pelvis disposition among postmenopausal women with and without utero-vaginal prolapse.

Methods: Postmenopausal women who met inclusion and exclusion criteria were randomly selected from Saveetha medical college and hospital inpatient and outpatient departments. Following assessment, the postmenopausal women with prolapse were assigned to Group A and without prolapse to Group B. The participants' angle of lumbar lordosis and pelvic inlet angle calculated in reference to lateral lumbosacral spine x-rays by a radiologist who was blinded for the study. The data were analyzed statistically using the Mann-Whitney test and Spearman's correlation test.

Results: There is a significant reduction in the lumbar lordotic angle and an increase in pelvic inlet angle in Group A (with prolapse) compared with Group B (without prolapse). Hence, there is an inversely proportional correlation between the lumbar lordosis and pelvic inlet angle.

Conclusion: The changes in lumbar lordosis angle and pelvic inlet orientation may cause pelvic floor muscle weakness, which indirectly contributes to utero-vaginal prolapse. This study certainly emphasizes the importance of postural analysis and corrective pelvic floor therapy regimens for women with utero-vaginal prolapse.

Keywords: Postmenopausal Period; pelvic floor; Uterine Prolapse; lordosis; Pelvic Girdle Pain

I. INTRODUCTION:

Pelvic floor dysfunction (PFD) comprises a multitude of symptoms, which affect the quality of life in approximately one-third of the women's population. Uterine prolapse affects 2%–20% of women around the world[1].In India, one in every five women visiting private clinics for other gynecological problems is diagnosed with utero vaginal prolapse[2].The pelvic organ prolapse occurs when the connective tissue, pelvic floor muscles, and fibro muscular walls fail to support the pelvic organs due to various factors[3]. The risk factors associated with pelvic floor dysfunction include ageing, multiple vaginal parity, pelvic surgery, collagen diseases, obesity, constipation, chronic respiratory disease and due to other lifestyle factors. Most women in developing countries like India, either as partof daily chores or at a working place involved in lifting heavy weights, even while pregnant or soon after delivery, contributes to high rates of prolapse[4,5]. Aside from the musculature and connective tissue of the pelvic floor, the bony pelvis and spinal curvature play a part in pelvic organ prolapse that has not been thoroughly studied. Previous

Studies have proclaimed that the lordotic curvature of the lumbar vertebrae and the pelvis arrangement protects the pelvic floor[6,7]. When the intra-abdominal force increases as a result of lifting weight or coughing, the force is deflected until it reaches the pelvis. The pelvic floor's orientation strength deteriorated with age due to a variety of factors, and it is claimed that the spinal column and bony pelvis failed to protect it from downward force. This might pave the way for postmenopausal women to experience pelvic floor weakness, which could lead to pelvic organ prolapse in prolonged existence [6,7].

As ageing progresses, the kyphotic and lordotic deviations of the thoracic and lumbar spine affect the curvature in adjacent spinal regions and can cause pelvic tilt. This in turn causes changes in the biomechanical properties of themuscles attached to it. In postmenopausal women, this may occur concurrently with the onset of utero vaginal prolapse[6]. However, current literature regarding the potential association of abnormal spinal curvature and pelvic tilts on pelvic floor support among postmenopausal Indian women has not been examined significantly. Therefore, this study attempts to determine the correlation between lumbar lordotic angle and pelvic inlet angle disposition among postmenopausal women with and without utero-vaginal prolapse.

II. MATERIALS AND METHODS:

This comparative single-blinded observational pilot study commenced with the approval of the human institutional ethical committee. In total, postmenopausal women (n=10) with utero vaginal prolapse (Group A) & postmenopausal women (n=10) without utero vaginal prolapse (Group B) were assigned. The women with five years of postmenopausal age, BMI < or = 24.9, two normal vaginal deliveries were randomly recruited from Saveetha medical college and hospital inpatient and outpatient department using a convenient sampling method. Women on oestrogen replacement therapy, women with increased intra-abdominal pressure due to occupation demands, previous pelvic/abdominal surgery, chronic cough and constipation, connective tissue disorders such as marfan syndrome, fixed spinal deformities, and conditions affecting the spinal canal or pelvic nerve roots were not included in the study[7]. After explaining the research procedures to the study participants, informed consent was obtained. The vaginal examination was done to rule out the existence and degree of uterovaginal prolapse for all the twenty women by the physiotherapist using pop q score classification. Following that, all of the women were taken for lumbar lordosis and pelvic inlet angle radiological analysis.A radiologist who masked for pop q score classification performed the X-ray interpretation. The lumbar lordosis angle was measured by drawing a line across the top of the first and fifth lumbar vertebrae. The intersection of these lines forms a lumbar lordotic angle. A line was drawn from the sacral promontory to the top of the pubic bone and to the vertical axis to measure the pelvic inlet angle[7]. The collected data was analyzed using SPSS version 22.

Results:

The outcome measures were computed in terms of lumbar lordotic angle and pelvic inlet angle. The data was analyzed statistically using theMann-Whitney test and spearman’s correlation test as the data violated the normality and sampling design assumptions. The measurement of the lumbar lordotic angle and pelvic inlet angle were statistically compared between the groups using the Mann-Whitney test shown in Table.1 and Fig.1. The result indicated a significant decrease (52.6%) in the lumbar lordotic angle for women in group A with uterovaginal prolapse (mean=30.41) compared to women in group B without uterovaginal prolapse (mean=14.42) (Table 1 & Figure 1). For measurement of pelvic inlet angle, there was a significant increase (25.2%) of pelvic inlet angle in group A women with uterovaginal prolapse (mean= 61.39) compared to women in group B without utero vaginal prolapse (mean=49.05) (Table 1 & Figure 1). Overall comparison results between both groups on lumbar lordotic angle and pelvic inlet angle revealed that there was a significant difference in lumbar lordotic angle between women in group A with uterovaginal prolapse and women in group B without uterovaginal prolapse ($Z=-3.780$, $p<0.001$). Likewise, for measurement of pelvic inlet angle, there was also a significant difference between women in group A and B ($Z=-3.780$, $p<0.001$) (Table 1).

Table: 1 Comparison of lumbar lordotic and pelvic inlet angle between group A and group B

		N	Mean	SD	SEM	Z^a	P
Lumbar lordotic angle	Group A-Test	10	14.42	3.45	1.09	-3.780	≤0.001
	Group B-Control	10	30.41	2.46	0.78		

Pelvic inlet angle	Group A-Test	10	61.39	2.67	0.84	-3.780	≤0.001
	Group B-Control	10	49.05	2.44	0.77		

Note: SD: Standard deviation; SEM: Standard error mean; [a]: Mann-Whitney test

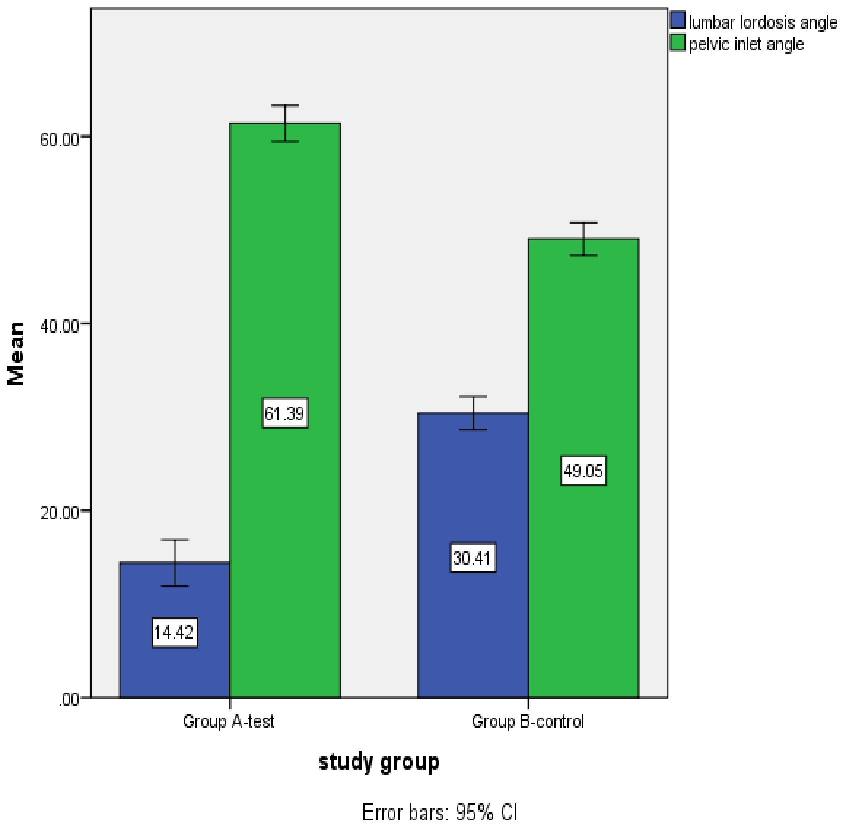

Figure 1: Comparison of lumbar lordotic angle and pelvic inlet angle between test group A and control group B

The spearman's correlation test was initially planned to assess the correlation between two outcome measures in test group A and control group B. Looking at the small sample size and non-probability sampling method that this study employed, which might influence research validity, bootstrapping was conducted to eliminate possible bias and further strengthen the correlation test.

Sideridis and Simons (2010)advocated the use of bootstrapping on small to moderate samples so to provide accurate estimates of population parameters, while Walter and Campbell (2004)also supported the use of bootstrapping in health-related data to make inference from non-normally distributed samples[8,9]. Further, Haukoos and Lewis (2005) demonstrated bootstrapping used in spearman correlation coefficient able to obtain more precise standard errors and confidence intervals[10]. The results from bootstrapping spearman's correlation test indicated a strong negative correlation between lumbar lordotic angle and pelvic inlet angle in test group A (r_s=-0.988, p<0.001), while in control group B, there was also a strong positive correlation between lumbar lordotic angle and pelvic inlet angle (r_s= 0.927, p<0.001). Additionally, the bootstrapping results indicated bias corrected accelerated (BCa) interval around the mean (bootstrap) correlation coefficient (Table 2). Results from bootstrapping standard errors and BCa intervals in both study groups showed test group A has a stronger relationship (SE=0.05; BCa95%CI:-1.000/-0.813) than control group B (SE=0.10; BCa95%CI:0.800/1.000) between lumbar lordotic angle and pelvic inlet angle (Table 2).

Table: 2 Correlation Coefficients between Lumbar Lordosis and Pelvic inlet angle for test group A and control group B

Group	Variable	Mean	SD	Bootstrap[c]		r_s	p
				SE	BCa95%CI Lower/Upper		
Group A-Test	Lumbar lordosis angle	14.42	3.45	0.05	-1.000/-0.813	-0.988	≤0.001
	Pelvic inlet angle	61.39	2.67				
Group B-Control	Lumbar lordosis angle	30.41	2.47	0.10	0.800/1.000	0.927	≤0.001
	Pelvic inlet angle	49.05	2.44				

Note: SD: Standard deviation; SE: Standard error; [c]bootstrap results are based on 10000 bootstrap samples; BCa: Bias corrected accelerated; CI: confidence interval; r_s ; Spearman's rho

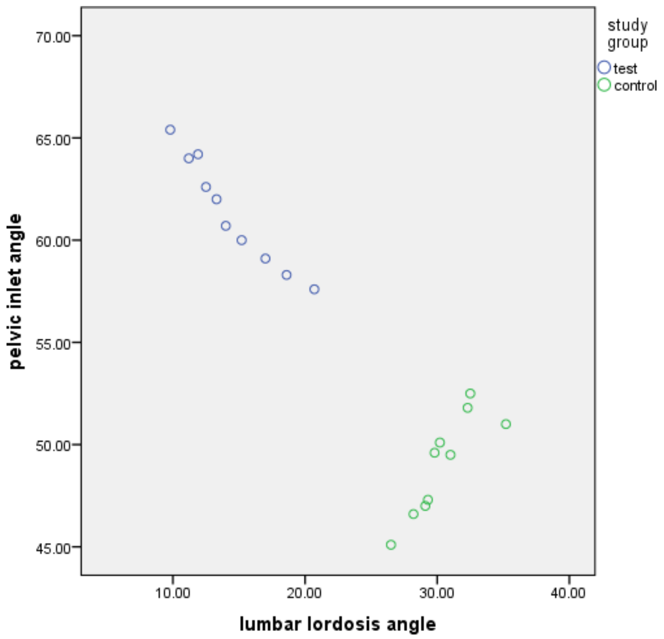

Figure 2: Scatter plot depicting correlation between lumbar lordosis angle and pelvic inlet angle in test group A and control group B

Further, examine the pattern of correlation between lumbar lordotic angle and pelvic inlet angle in both study groups in the scatter plot (Figure 2). It depicts a positive correlation between lumbar lordotic angle and pelvic inlet angle in the control B group, whereas in test group A, a negative or inverse correlation between lumbar lordotic angle and pelvic inlet angle was observed.

III. DISCUSSION:

In this study, we have found that women with utero vaginal prolapse show greater pelvic inlet angle and reduced lumbar lordotic angle. Hence, the utero vaginal prolapse is directly related to pelvic inlet angles and inversely related to lumbar lordotic angles. We have hypothesed that the changes occurred in pelvic inlet orientation and spinal curve contributed to pelvic organ prolapse among post-menopausal women. This could be presumably due to the changes that occurred in the connective tissues during their parity or due to their lifestyle, because the occupation of most of the women with pelvic organ prolapse shows that they were working on construction sites foran extended period of time.

Along with this, theirpoor nutrition may lead to insufficient tissue tensile strength and, above all, aging contributes to changes in bone alignment, which causes utero vaginal prolapse. Women with these changes may progress slowlyconcerned with pelvic floor muscle power even after long-term pelvic floor exercise, as there is a perturbation in the muscle properties. Therefore, the pelvic floor disorders should not be lumped together and it is essential to know that diverse pelvic floor structures are associated with different pelvic floor disorders. Hence, it is advisableto considerthe four subcategoriesin the pelvic floor disorders as (prolapse, descending perineal syndrome), constrictor function (urinary and fecal incontinence), dysfunctions of pelvic floor contraction (fecal and urinary incontinence) and relaxation (constipation and urinary retention). Consequently, the‘‘splitter approach’’ may be useful in selecting particular treatment methods and effective treatment for different pelvic floor disorders[11].

The anatomical and patho-mechanical changes influence the pelvic floor structure to a considerable extend[11].The structural elements, which include the pelvic floor musculature, connective tissue condensations, and fibromuscular walls of the pelvic viscous work together to providepelvicorgan support. The pelvic organs are supported at three different levels in which level-I supported by uterosacral-cardinal ligament complexes, level-II supported by arcus tendinous fasciae pelvis and superior fascia of levatorani muscle,and level-III supported by the tissues around the vaginal outlet. Apart from these three levels of support system, the forward lumbar curvature in the lumbar spine and orientation of the pelvis also play a role in the pelvic floor strength. Coughing, sneezing, exercisingand lifting heavy weight activities wouldincrease the intra-abdominalpressure, which leads to deflection at normal lumbar spine level before it reaches the pelvic floor stability. Thus, less tension is placed on the pelvic floor, which is arranged transversely across the lower trunk[3]. Women with pelvic organ prolapse (group A) lack lumbar stability, which raises intra-abdominal pressure and appears to reduce the strength of the pelvic floor structure, causing failure in longevity.

On the other hand, the pelvic inlet is orientated almost vertically that plays animportant role in directing the intra-abdominal force to the pelvis. When the pelvic inlet is disheveled, intra-abdominal forces act directly on the pelvic floor muscles[7]. Besides, an increase in pelvic inlet anglemightstretch the pelvic floor muscles. According to young’s modulus theory, when the material is stressed up to the elastic limit is removed, the material resumes its original size and shape. Stresses beyond the elastic limit cause a material to yield or flow. Similarly, when the tissue is stretched beyond its physiological limit, the resilience or capability of the tissue to return to its original length after stress is taken off will be lost and the resting tension and homeostatic equilibrium is also interrupted. Reay Jones et al. (2003) discovered that the uterosacral ligament was less resilient and had a smaller diameter in postmenopausal women undergoing hysterectomy[12].

Rafi suzme et al. (2007) found that there is an increase in the diameter of the 30% of collagen fibrils in connective tissues, especially on uterosacral ligaments in post-menopausal women, which brings rigidity of extracellular matrix, thus resulting in impairment in the connective tissues[13]. If the connective tissue is impaired, then the load will be transmitted to the muscle. The prolonged stretch due to an increase in load within the pelvic muscle alters the length tension relationship of the pelvic floor muscle, resulting in plasticity. Marianna Alperin et al.(2016) found that increased fiber length in more proximal pelvic floor muscles represents an adaptive response to the chronically increased load exerted on the muscle by the displaced apical structures[14]. The pelvic organ is presumably more dependent on the pelvic floor muscles because of the passive tissue weakness, resulting in stretched pelvic floor muscles. Eventually, this will cause the pelvic floor muscle to lose its biomechanical properties, likely resulting in weakness.

In general, the neutral lumbar lordosis and good pelvic orientation of the pelvic floor muscle also get involved by contracting reflexively by maintaining the increase in the intra- abdominal pressure. Thus, it braces and minimizes the tension that is placed on the endopelvicfascia, which providesthe primary level of support[3]. According to MacLennan et al.(2000), post-menopausal women are more prone to pelvic floor dysfunction as age increases due to a decrease in muscle mass. Skeletal muscle strength peaks between the ages of 20 and 30 and then begins to deteriorate at a rate of 5% per decade[15].A study by Perucchini et al. (2002) reported that a 3% reduction in urethral striated muscle thickness from the aged population.It shows that the pelvic floor muscle turns down certainly as age progresses. Therewill be a reduction of collagen-I in the pelvic floor muscle due to oestrogen hormone depletion and bony changes in the vertebrae are expected because of osteoporosis[16]. Similarly, the current study found that all of these factors contribute to pelvic floor muscle loss in postmenopausal women.

Other than that,this study has few limitations by excludingkyphotic measurements for utero vaginal prolapse, which needs distinctive X-ray exposure. Correlation between various pelvis measurements such as pelvic arch, inter tuberous & inter spinous diameter, transverse diameter of pelvic inlet, Sacro coccygeal length, depth of sacral curvature and other forms of pelvic organ prolapse can be studied widely with various spinal pelvic

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dispositions.Recently, researchers have studied the gene encoding of fibulin 5 expression in women with pelvic organ prolapse[17]. Future studies can be carried out to identify the gene expression status and dermatoglyphic patterns to analyze the genetic instability.

IV. CONCLUSION:

The present study concludes that the loss of lumbar lordosis and pelvic inlet orientation changes might lead to pelvic floor muscle weakness, which consequently contributes to the utero vaginal prolapse indirectly. The posture assessment and correction exercises can also be incorporated along with pelvic floor exercises for better results. Perhaps, young primipara or multipara women may not be susceptible to symptoms of pelvic floor dysfunction because their pelvic tissues may regain strength soon after surgery or labour. However, ageing brings adverse changes in mechanical properties of connective tissues such as collagen and elastin. This leads to poor prognosis in pelvic floor muscle strength or reduction in symptoms among the geriatric population even after intensive pelvic floor muscle training.

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Conflict of Interest: The author declares that there is no conflict of interest.

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