

MEASUREMENT OF ANTERIOR PELVIC TILT IN LOW BACK PAIN - AN OBSERVATIONAL STUDY**MALARVIZHI D*, SAI KISHORE VARMA R, SIVAKUMAR VPR**Department of Physiotherapy, SRM College of Physiotherapy, SRM University, Chennai, Tamil Nadu, India.
Email: Malarvizhi.d@ktr.srmuniv.ac.in*Received: 20 November 2016, Revised and Accepted: 05 January 2017***ABSTRACT****Objective:** The objective of the study was to measure the anterior pelvic tilt for both males and females of low back pain patients.**Methods:** Observational type. Procedure: Totally, 120 subjects were approached. In that 70 were males and 50 were females. Using i@handy application in mobile anterior pelvic tilt was calculated among low back pain patients.**Results:** Anterior pelvic tilt was increased in low back pain patients (male - 14.15° and female - 16.26°). In that correlation between males and visual analog scale (VAS) was not significant. However, there was a significant correlation found in female anterior pelvic tilt and VAS ($p < 0.01$).**Conclusion:** This study concluded that there was an increase in anterior pelvic tilt among low back pain patients. Anterior pelvic tilt and VAS was highly correlated in females, not in males.**Keywords:** i@handy, Anterior pelvic tilt, Low back pain.© 2017 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>) DOI: <http://dx.doi.org/10.22159/ajpcr.2017.v10i4.16254>**INTRODUCTION**

Low back pain is neither a disease nor a diagnostic entity of any sort. The term refers to pain of variable duration in an area of the anatomy afflicted so often that it is has become a paradigm of responses to external and internal stimuli. Low back pain may be classified by duration as acute if pain lasting <6 weeks, subchronic if pain is lasting for 6-12 weeks, or chronic if pain is lasting for more than 12 weeks [1,2].

Low back pain is a leading cause of disability. It occurs in similar proportions in all cultures, interferes with the quality of life and work performance, and was the most common reason for medical consultations. Samuel showed subjects were taking self-medications for low back pain (3.01%) [3]. Few cases of back pain were due to specific causes; most cases are non-specific.

The acute back pain was the most common presentation and was usually self-limiting, lasting <3 months regardless of treatment. Chronic back pain is a more difficult problem, which often has strong psychological overlay: Work dissatisfaction, boredom, and a generous compensation system contribute to it.

Low back pain that lasts at least 1 day and limits activity is a common complaint. Globally, about 40% of people have low back pain at some point in their lives, with estimates as high as 80% of people in the developed world [4].

Approximately, 9-12% of people in 632 million have low back pain at any given point in time, and nearly one quarter 23.2% report having it at some point over any 1-month period. The difficulty most often begins between 20 and 40 years of age. Low back pain is more common among people aged 40-80 years [5].

World Statistical Review in 2012 reported a rate of 9.6% among males and 8.7% among females. Another 2012 World Statistical Review found a higher rate in females than males, which the reviewers felt was possibly due to greater rates of pains due to osteoporosis of bones, during menstruation, and pregnancy among women. An estimated 70%

of women experience back pain during pregnancy [2]. Iyer (2013) done a study on osteoporotic low back pain and got significant improvement in back pain and quality of life [6].

The anterior pelvic tilt is postural distortion which is caused by long sitting posture which tightens the hip flexors which pulls the pelvis down which creates excessive lumbar lordosis in spine which causes strain and pain. Anterior pelvic tilt is caused by increased lumbar lordosis, and thoracic kyphosis stretched abdominal muscles and tightened hip flexors. The normal pelvic tilt angle for anterior superior iliac spine to posterior superior iliac spine 0-23 degrees with a mean of 13 and standard deviation of 5° [7].

In an anterior tilt, the pelvis tips downward in an anterior direction, so the pubic symphysis moves inferiorly. There is only a minor degree of movement capable at the sacroiliac (SI) joint. The actual axis of rotation for anterior pelvic tilt is at the tibiofemoral hip joint [7].

An anterior pelvic tilt is most commonly caused by the tightness in the iliopsoas and rectus femoris muscles combined with tightness in the erector spinae, multifidus and quadratus lumborum muscles produce the anterior tilt. These muscles act like a force couple to produce the anterior rotation [8,9].

Using one plus 2 mobile with i@Handy level (i@Handy Soft, Inc., New York, USA) application was used for this investigation. The i@HandyR level application is a free application with a visual display similar to that of a digital inclinometer in regard to numeric size. The application uses the one plus-2 built-in accelerometer and a digital display to display the angle measured. There is no reported accuracy of this application by the manufacturer. Smartphones such as the iPhoneR and those that use the Android™ operating system have free applications such as the i@HandyR level that provide the capacity to convert the phone into an inclinometer using a built-in tilt sensitive system [4].

The aim of this study was to find whether there was any relation between anterior pelvic tilt and low back pain exist in Indian population.

METHODS

The study design was non-experimental, and study type was observational. Inclusion criteria for selecting subjects were low back pain, age from 20 to 40 years, both male and females, visual analog scale (VAS) score <7 were included in this study. Exclusion criteria for subjects were any history of recent fracture of lower limb, with hereditary disorders, history of recent surgery of spine and lower limb, body mass index >30 were excluded, sacroiliac joint dysfunction, neoplasm, tuberculosis spine, referred pain (internal organs such as gall bladder and kidney).

Procedure

Patients with low back pain were approached, and 120 samples were taken, in that males - 70 and females - 50 according to the inclusion and exclusion criteria, the procedure was explained, and consent was taken to participate in the study. Institutional Ethical Committee approval was obtained before starting the study. Scores of the low back pain was taken by VAS and noted. After obtaining the patients the anterior superior iliac spine and posterior superior iliac spine were palpated properly of each patient. Using the software named i@handy in an Android device of one plus 2 mobile was used to measure the pelvic tilt. The i@handy which was the measuring device was made set at the angle of 0.0°. Moreover, the subject with low back pain was positioned in prone lying and skin overlying the L5-S1 intervertebral space marked with a semi-permanent pen. The subject then assumed the long sitting position with soles of their feet against a wall perpendicular to the sitting surface. Then the patient was instructed to relocate the ischial tuberosities to more posterior position. Contact of the heels with the wall was re-checked to ensure maintenance of starting position.

The instruction was given to patient like "I want you to lift your chest towards the wall. Try to stay the same height as you move forwards from the hips. Go forward as far as you can. Stop when you feel your knees start to lift under your hands or you feel that you cannot go any further. I want you to hold at your maximum, do not bounce." This position was held for 10 seconds only. The active range was only assessed, no additional passive range was given. Then opening the software in mobile and the mobile was aligned with the skin marker overlying the L5-S1 intervertebral space and held in contact with the skin overlying the posterior sacrum. Once the mobile was in the position, the hold button was used to freeze the angle. The measurement device was removed, and the angle representing maximum anterior pelvic tilt range was recorded. The procedure was repeated for three times, and the best angle in this three trials will be taken as the anterior pelvic tilt of the patient [4,10].

RESULTS

Statistics were done using IBM SPSS (version 20). The correlation study was done between male and female for anterior pelvic tilt in low back pain.

The results of this study were, in Table 1 the mean value between VAS and anterior pelvic tilt shows that there was an increase in anterior

pelvic tilt in male patients with low back patients clinical. Normal value for male was 13° but mean, and standard deviation value got in this study was 14.147°±0.6665. This shows there was an increase in the anterior pelvic tilt of males with low back pain. However, there was no statistically significant correlation between VAS and anterior pelvic tilt in the male. In Table 2, the mean value between VAS and anterior pelvic tilt shows that there was an increase in anterior pelvic tilt in female patients with low back patients. Normal value of anterior pelvic tilt was 15 for female but mean, and standard deviation value got in this study was 16.2660±0.48807. This proved that females anterior pelvic tilt was more in low back pain patients. And also there was a significant correlation between VAS and female anterior pelvic tilt.

Hence, According to Graph 1 and 2, there was a significant correlation between anterior pelvic tilt and low back in females whereas in males there is no correlation of anterior pelvic tilt and low back pain.

Table 1 shows that the mean value of anterior pelvic tilt in males with low back pain is (14.1471) which is increased than the normal anterior pelvic tilt. There is no significant correlation between VAS and anterior pelvic tilt in males (p<0.001).

Table 2 shows that the mean value of anterior pelvic tilt in females with low back pain is (16.2660) which is increased than the normal anterior pelvic tilt. There is a significant correlation between VAS and anterior pelvic tilt in females (p<0.001).

DISCUSSION

The main objective of the study was to measure the anterior pelvic tilt among low back pain patients. 120 samples were taken in that males 70 and females 50. The result of this study shows that there was an increase in anterior pelvic tilt for both males and females with low back pain. It was measured by mobile application named as i@handy. In this study, both male and females of low back pain patients had more anterior pelvic tilt shown in Tables 1 and 2.

The anterior pelvic tilt simultaneously creates an exaggerated lumbar lordosis. Individuals with this postural distortion are have weak abdominal muscles and need to focus on strengthening exercises to offset the postural distortion. However, if the underlying muscular dysfunction of the hip flexors and low back extensors is not addressed, strengthening exercises of the abdominal muscles will have little benefit when the pelvis tilts to one side it creates joint malalignments throughout the spine. This now creates abnormal joint stresses resulting in wear and tear, joint capsule disruption, and eventually pain. Uncorrected anterior pelvic tilt leads to chronic low back pain, lumbar disc degeneration, disc herniation or disc bulge, SI joint pain, muscle strain, pain in hip, and facet syndrome. Pelvic tilt is normally calculated as "the angle between the ground and a line drawn between the anterior superior iliac spine and the posterior superior iliac spine of the pelvis" [8]. The iliopsoas and rectus femoris work together with the erector spinae to produce anterior pelvic tilt.

Table 1: Correlation of VAS and anterior pelvic tilt in males with low back pain

S.No.	Variables	Mean difference	Standard deviation	Degree of freedom N-2	Pearson correlation	Significant
1	VAS male	5.0286	0.81599	68	0.072	0.553
2	Anterior pelvic tilt male	14.1471	0.66653	68	0.072	0.553

VAS: Visual analog scale

Table 2: Correlation of VAS and anterior pelvic tilt in females with low back pain

S.No.	Variables	Mean difference	Standard deviation	Degree of freedom N-2	Pearson correlation	Significant
1	VAS female	4.9400	0.73983	48	0.362**	0.010
2	Anterior pelvic tilt female	16.2660	0.48807	48	0.362**	0.010

VAS: Visual analog scale, Significant value p<0.01

Tripathy *et al.* found that 90% of female subjects were having low back pain as the most common symptom [11].

Waddell (1992) found that there was an increased anterior pelvic tilt in patients with low back pain which was correlated with this study. It was due to the difference between male and female anatomy start with the structure of pelvis and follow through the knee. The male pelvis is small and due to more muscular activity and the position of pelvis the angles cannot be measured accurately. The female pelvis is smaller on average than the male pelvis to accommodate childbirth, the cavity of the female pelvis is shallower, wider, and more circular, with a shorter and wider sacrum, more movable coccyx, and larger superior and inferior openings. This difference in pelvis, results in high anterior pelvic tilt in females while compared to males [12,13].

Low back pain patients show increased anterior pelvic tilt than normal value for both male and females. It was due to increased lumbar lordosis due to anterior pelvic tilt which leads to low back pain. This is supported by Moll and Wright (1992), also said that anterior pelvic tilt and exaggerated lumbar lordosis have been suggested to increase loading on the vertebral column [14,15].

Jull and Janda (1987), also said that the forward rotation of the pelvis, referred to as anterior pelvic tilt, was accompanied by an exaggerated lumbar lordosis and was believed to be associated with a number of common musculoskeletal conditions, including low back pain and SI joint dysfunction. The mean value of anterior pelvic tilt was $14.147^{\circ} \pm 0.6665$ which was greater than normal value, but there was no significant correlation between VAS and anterior pelvic tilt of male low back pain patients which was shown in Table 1. It may be due to small sample size and also depends on abdominal muscle and core muscle weakness of an individual. And also may be due to the instrument which was used for measuring pelvic tilt (i@handy). In addition, anterior pelvic tilt has been associated with a loss of core stability because of length-tension relationship, therefore, the degree of pelvic tilt has been used to assess core muscle strength [16,17].

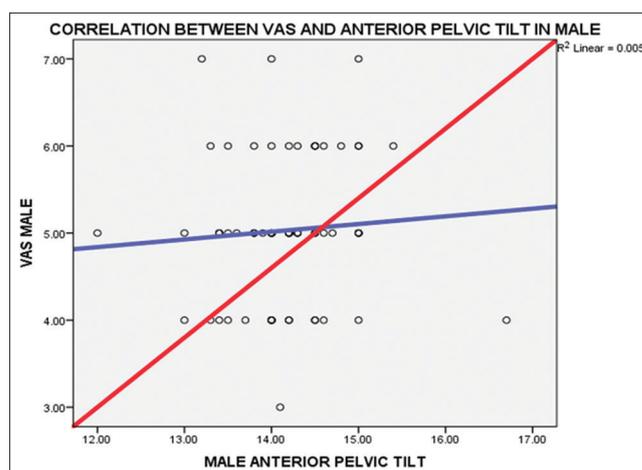
Walker *et al.* (1987), concluded that there was a relationship between lumbar lordosis, pelvic tilt, and abdominal muscle performance. And also this study also shows there was a significant correlation between VAS and anterior pelvic tilt of female low back pain patients shown in Table 2. The mean value of the anterior pelvic of female with low back pain was 16.2660 ± 0.48807 which was more than the normal value. Females usually have more anterior pelvic tilt which cause increased lordosis, and also abdominal muscle weakness leads to anterior pelvic tilt [18-20].

Based on the anatomic position of female pelvis and function of the abdominal muscles, it has been showed that abdominal muscle weakness produces an anterior pelvic tilt and exaggerated lumbar lordosis, resulting in low back pain. Even postural changes lead to increase in anterior pelvic tilt and cause low back pain. For girls even wearing heels leads to increased anterior pelvic tilt and cause low back pain. This may lead to weak core muscles and abdominal muscles. However, many studies show contradictory to this study that there was no relation between low back pain and anterior pelvic tilt [21,22].

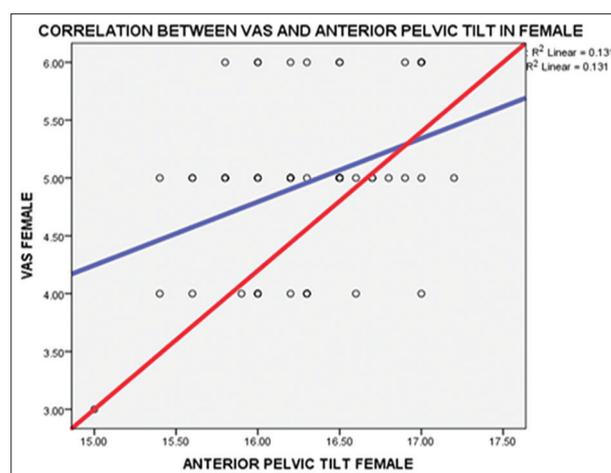
Petrone *et al.* (1992) found that an 8-week strengthening exercise program for the core muscles increased abdominal muscle strength but had no effect on the size of the lumbar lordosis of the subjects. More research is needed to describe the cause of core muscle weakness in patients with low back pain. Thus, this study shows anterior pelvic tilt of low back patients were high than normal value, in males and females [23-25].

CONCLUSION

The study concluded that there was an increase in anterior pelvic tilt of low back pain patient when compared to normal value. There was no significant correlation between VAS and anterior



Graph 1: Correlation of visual analog scale and anterior pelvic tilt in males with low back pain



Graph 2: Correlation of visual analog scale and anterior pelvic tilt in females with low back pain

pelvic tilt for male low back pain patients. There was a significant correlation between VAS and anterior pelvic tilt for female low back pain patient.

We suggest the study can be done with large number of samples and also for acute low back pain patients and measure anterior pelvic tilt range of motion use other forms of objective measurements like inclinometer can be used in future studies.

REFERENCES

1. Nachemson A, Lindh M. Measurement of abdominal and back muscle strength with and without low back pain. *Scand J Rehabil Med* 1969;1(2):60-3.
2. Mayer TG, Tencer AF, Kristoferson S, Mooney V. Use of noninvasive techniques for quantification of spinal range-of-motion in normal subjects and chronic low-back dysfunction patients. *Spine (Phila Pa 1976)* 1984;9(6):588-95.
3. Samuel SS. Assessment of self medication among patients attending community pharmacies in Erode India. *Int J Pharm Pharm Sci* 2013;3(4):258-62.
4. McEvoy MP. Anterior pelvic tilt in elite cyclists - A comparative matched pairs study. *Phys Ther Sports* 2007;2(1):75-80.
5. Day JW, Smidt GL, Lehmann T. Effect of pelvic tilt on standing posture. *Phys Ther* 1984;64(4):510-6.
6. Iyer RN. Assessment of efficacy, safety and quality of life in postmenopausal women with osteoporosis using Salmon calcitonin nasal spray. *Asian J Pharm Clin Res* 2013;6(2):117-9.

7. Gajdosik R, Simpson R, Smith R, DonTigny RL. Pelvic tilt. Intratester reliability of measuring the standing position and range of motion. *Phys Ther* 1985;65(2):169-74.
8. Walker ML, Rothstein JM, Finucane SD, Lamb RL. Relationships between lumbar lordosis, pelvic tilt, and abdominal muscle performance. *Phys Ther* 1987;67(4):512-6.
9. Elnaggar IM, Nordin M, Sheikhzadeh A, Parnianpour M, Kahanovitz N. Effects of spinal flexion and extension exercises on low-back pain and spinal mobility in chronic mechanical low-back pain patients. *Spine (Phila PA 1976)* 1991;16(8):967-72.
10. Alviso DJ, Dong GT, Lentell GL. Intertester reliability for measuring pelvic tilt in standing. *Phys Ther* 1988;68(9):1347-51.
11. Tripathy A. A retrospective study of clinical profile and drug prescribing pattern in osteoporosis in a tertiary care hospital. *Int J Pharm Pharm Sci* 2015;7(10):390-3.
12. Waddell G, Somerville D, Henderson I, Newton M. Objective clinical evaluation of physical impairment in chronic low back pain. *Spine (Phila PA 1976)* 1992;17(6):617-28.
13. Bogduk N. The sources of low back pain. In: Jayson MI, editor. *The Lumbar Spine and Back Pain*. 4th ed. Edinburgh: Churchill Livingstone; 1992. p. 71-2.
14. Moll JM, Wright V. Measurement of spinal movement and function. In: Jayson MI, editor. *The Lumbar Spine and Back Pain*. 4th ed. Edinburgh: Churchill Livingstone; 1992. p. 173-205.
15. Beninato M, Hudson KR, Price KS. A study of the correlation among lumbar lordosis, pelvic tilt, hamstring and hip flexor muscle length. *J Orthop Sports Phys Ther* 1993;17:61.
16. Saur PM, Ensink FB, Frese K, Seeger D, Hildebrandt J. Lumbar range of motion: Reliability and validity of the inclinometer technique in the clinical measurement of trunk flexibility. *Spine (Phila Pa 1976)* 1996;21(11):1332-8.
17. Youdas JW, Garrett TR, Harmsen S, Suman VJ, Carey JR. Lumbar lordosis and pelvic inclination of asymptomatic adults. *Phys Ther* 1996;76(10):1066-81.
18. Levine D, Walker R, Tillman LJ. The effect of abdominal muscle strengthening on pelvic tilt and lumbar lordosis. *Physiother Theory Pract* 1997;13:217-26.
19. Lee D. *The Pelvic Girdle: An Approach to Examination and Treatment of the Lumbo-Pelvic-Hip Region*. 2nd ed. New York, NY: Churchill Livingstone; 1999.
20. Bible JE, Biswas D, Miller CP, Whang PG, Grauer JN. Normal functional range of motion of the lumbar spine during 15 activities of daily living. *J Spinal Disord Tech* 2010;23(2):106-12.
21. Lee JH, Hoshino Y, Nakamura K, Kariya Y, Saita K, Ito K. Trunk muscle weakness as a risk factor for low back pain. A 5-year prospective study. *Spine (Phila PA 1976)* 1999;24(1):54-7.
22. Ng JK, Kippers V, Richardson CA, Parnianpour M. Range of motion and lordosis of the lumbar spine: Reliability of measurement and normative values. *Spine (Phila PA 1976)* 2001;26(1):53-60.
23. Petrone MR, Guinn J, Reddin A, Sutlive TG, Flynn TW, Garber MP. The accuracy of the palpation meter (PALM) for measuring pelvic crest height difference and leg length discrepancy. *J Orthop Sports Phys Ther* 2003;33(6):319-25.
24. O'Sullivan P. It's time for change with the management of non-specific chronic low back pain. *Br J Sports Med* 2012;46(4):224-7.
25. Lim HS, Roh SY. The relationship between pelvic tilt angle and disability associated with low back pain. *J Phys Ther Sci* 2013;10:236-42.