©2022 The Academy of Environmental Biology, India
Journal of Ecophysiology and Occupational Health, *Vol 23(1), DOI: 10.18311/jeoh/2023/32074, 8-13, March 2023*

ISSN (Online) : 0972-4397
ISSN (Online) : 0974-0805

Evaluation of Lumbar Lordosis and Hip Extensor Strength in Postpartum Woman with Pelvic Girdle Pain - A Case Control Study

Mani Mohanieshwari and Jincy Samuel*

Department of Physiotherapy, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India; physio.kric@krupanidhi.edu.in

Abstract

Background: Pelvic Girdle Pain (PGP) is a musculoskeletal pain that arises between the posterior iliac crest and gluteal fold, at the sacroiliac joint and also radiates posteriorly in the thigh. PGP give rise to very intense pain and disability than Low Back Ache (LBA). It is a common condition during pregnancy and post-delivery. Joint laxity increases pelvic rotation and lumbar lordosis which results in adaptive hip extensor muscle weakness. Hence the studies focus on identifying the lumbar lordosis and hip extensor strength of PGP. **Aim of the Study:** To identify the association between lumbar lordosis and PGP and to identify the association between hip extensor strength and PGP among post-partum women. **Material and Methodology:** Based on inclusion and exclusion criteria a total of 80 postpartum women were assessed based on the diagnostic criteria the women were divided into two groups. Group A consists of women with PGP and group B consists of women without PGP. Both groups were assessed for lumbar lordosis using flexicurve and hip extensor strength using a manual muscle tester. Data collected was analyzed using. **Outcome Measure:** Flexicurve to assess lumbar lordosis. Manual muscle tester to assess hip extensor strength. **Result:** The study showed that the mean lumbar lordosis was significantly higher in women with PGP than in women without PGP, p = 0.001. There was a 15.46° ± 6.91° higher angle observed in persons who had pelvic girdle pain compared to those who did not have pelvic girdle pain. The mean hip extensor strength for group 'A' (average of right and left side) was 12.74 ± 0.73kg, whereas it was significantly higher in group 'B'. **Conclusion:** The study concludes that there is a positive association between lumbar lordosis and hip extensor weakness in pelvic girdle pain.

Keywords: ASLR Test, Flexicurve, Pelvic Girdle Pain (PGP), Posterior Pelvic Pain Provocation Test, Sacroiliac Joint (SIJ)

1. Introduction

Pelvic Girdle Pain (PGP) is a musculoskeletal pain that arises between the posterior iliac crest and gluteal fold, at the sacroiliac joint and also radiates posteriorly in thigh 1. It also has signs and symptoms indicating pain originating from the Sacro-Iliac Joint (SIJ) and surrounding soft structures such as connective tissue and myofascial. The pain or discomfort must be reproducible by clinical tests[1–3].

PGP give rise to very intense pain and disability than Low Back Ache (LBA)[1]. It affects the endurance capacity of walking, standing and sitting[1]. Many theories suggest that there could be an underlying reason for SIJ getting "displaced" or "fixated" and ending up in "positional faults"[3]. PGP can be classified into two type's Specific PGP and Non-Specific PGP. Specific PGP is associated with specific pathological conditions such as infections, sacroiliitis, inflammatory arthritis, and fracture. Non-specific pelvic girdle pain has no identified pathoanatomical basis. It may occur due to factors such as hormonal, and biomechanical aspects, inadequate motor control and ligament stress, and increased shear force on pelvic joints and it can also arise during pregnancy or postdelivery[1,3].

PGP is a very well-known condition which occurs during pregnancy and post-delivery. Worldwide PGP is attributed to be 50% prevalent due to pregnancy[4].

Author for correspondence

According to an epidemiological study, 20% of women during pregnancy develop Pelvic Girdle Pain and continued to have symptoms 3 years post delivery[5]. It has an incidence as high as 46% to 58%. Another study states that Pelvic joint pain due to pregnancy persists in 8.5% of women at least 2 years after childbirth[2].

Pelvic Girdle Pain turns out to be chronic despite the absence of any pathoanatomical abnormalities, radiological abnormalities, or inflammatory conditions detected through blood screening[3].

Pelvis is a structure which transfers the load to the trunk and the legs. Pelvic stability helps in reducing shear forces across the joints. Improper load on the pelvis leads to overload on the pelvic ligaments which in turn leads to PGP1. The recent theory states that lack of lumbopelvic motor control causes disturbance in the load transfer through the pelvis and it may cause peripheral nociceptive drive of symptoms[3].

The loading of the spine and pelvis increases during pregnancy due to uterus loading. The changes that occur during pregnancy are laxity of pelvic ligaments, softening of the pubis symphysis, Line of Gravity (LOG) changes, and orientation of the pelvis[5]. Pelvic instability occurs due to mechanical and hormonal changes leading to a change in the soft structures to constant loading[5]. Hyperlordosis occurs due to a shift in COG as uterus loading happens in pregnancy. It in turn increases the load on the lumbar spine[6]. Hyperlordosis and weakness of core muscles may persist 6 months post-delivery and it may also lead to LBA[7].

PGP does not occur from the joint alone; the other contributing factors are insufficiency of the pelvic muscles, strained ligaments, joint capsules, and muscle dysfunction which in turn can lead to affect the stability of the pelvis. In functional activities such as walking and standing, hip extensors play an important role than hip flexors, and knee muscles[8]. Hip muscle weakness can have an association with alteration in the knee, hip, pelvis and trunk kinematics[9].

Increased lumbar lordosis limits the spinal range of motion and causes hip extensor weakness. A further weakness of the hip muscles and pelvic instability increases the lumbar lordotic curve.

Muscle dysfunction can be an important factor for long-term PGP. In chronic PGP, it is diagnosed that there is an association between hip extensor muscle weakness and poor endurance in back muscles[10,11].

Pregnancy hormones cause laxity of the Sacroiliac joint and the alignment of the pelvis is affected. It leads to LBA and PGP. A detailed assessment is required to identify the risk of developing lumbopelvic disorders in women[12]. There is a scarcity of studies done on finding if lumbar lordosis and hip extensor muscle weakness result in Pelvic girdle pain. Identifying the association of lumbar lordosis and hip extensor strength with PGP is needed so that management strategies addressing these factors can be incorporated and long-term disability associated with PGP can be prevented.

The objectives of the research were:

- To identify the association between lumbar lordosis and pelvic girdle pain among post-partum women.
- To identify the association between hip extensor strength and pelvic girdle pain among post-partum women.

2. Methodology

Approval to continue with the research work was granted by the ethical board of our institution to assess the patients necessary for this research. The subjects were then given a brief introduction about the purpose of this research, the procedures to be undertaken, possible risks as well as the benefits. Upon the approval of the participants, a signed consent form was attained. The general condition of the patient was assessed.

Our Study is a case-control study. The study setting and the source of data were postnatal women taken from a maternity hospital in Bangalore. The duration of the study was 6 months. 80 postnatal women between the age of 20-35 years, 2 months to 2 years post delivery were taken in the study. The participants were divided into two groups i.e., Group A (subjects with pelvic girdle pain) and Group B (subjects without pelvic girdle pain) based on the diagnostic criteria.

Active Straight Leg Raise test (ASLR) and Posterior Pelvic Pain Provocation (P4) test were used as diagnostic tests for PGP The subjects who tested positive for both diagnostic tests were considered for the case group (group A) and a subject who was not positive were considered for the control group (group B).

Both the group subjects were assessed to check lumbar lordosis using flexicurve and maximum voluntary isometric hip extension using Lafayette manual muscle tester device

2.1 Diagnostic Criteria

In the ASLR test, the subjects who scored 2 and above were considered positive[13] and the P4 test was used to diagnose Pelvic girdlepain[13–16]. The test was said to be positive when the patient could feel the same pain in the gluteal area on the provoked side[17,18].

Outcome measures that were used were, flexicurve used to assess the lumbar lordosis and manual muscle tester used to assess voluntary isometric hip extension.

3. Outcome Measures

3.1 Flexicurve

The measurement was taken with the participants in a standing position. The flexible ruler was placed over the lower back on the lumbar spinous process and shaped to fit the contours of the spinal curve. The instrument was carefully removed and the curvature was drawn on white paper. A vertical line was drawn to connect the T12 and S2 landmarks (total length of curvature/L line). First the maximum width was noted (H) and then the middle of the lumbar curvature length was measured in centimetres.

The angle, theta(θ) will be determined by using these measurements

Angle (θ) = 4 X [arctan (2H/L)] where [θ] represents the degree of the lordotic curve[19,20]. The range of 20-45 degrees is considered normal[21,22].

3.2 Manual Muscle Tester (MMT)

Maximum voluntary isometric contraction for hip extensors was measured with the Lafayette MMT device. Before the test, the device was calibrated. The hip extension was tested in a prone position with the hip in 90 degrees of flexion. The manual muscle tester device was placed above the popliteal fossa. A strap was placed over the pelvis to provide stabilization. The participant had a sling around the thigh. Participants were commanded to "pull the leg as hard as you can until I stop you after 5 sec".The therapist did not encourage the participants during the test. Two training repetitions were done and the next 3 repetitions' mean was analyzed. Each time the participant held the activity for 5 secs and took 5-10 sec of rest. The values were determined for both legs[8,21].

4. Results

4.1 Statistical Analysis

It is inferred from Table 1 that the mean age of group 'A' was 26.33 ± 3.15 years, and it was 26.33 ± 3.34 for group 'B.' There was an insignificant difference in the age between groups Z = 0.07, P = 0.942.

The mean BMI was 22.51 ± 2.40 for group 'A' and 23.45 ± 2.76 for group 'B,' and the difference was statistically insignificant between groups, Z = 1.39, P = 0.164.

It is inferred from Table 2 that, the mean ASLR score was 4.20 ± 1.34 for group 'A' and it was 0.45 ± 0.51 for group 'B'; the mean difference in the score between groups was 3.75 ± 0.79. The difference in the ASLR score was statistically significant between the groups, z = 7.89, p = 0.001<0.05.

It is inferred from Table 3 that, the mean lumbar lordosis was significantly higher in group A, M = 64. 27° ± 2.28° than in-group 'B', M = 48.81° ± 7.23°, t=12.91, p = 0.001. There was a 15.46° ± 6.91° higher angle was observed in group 'A' compared to group 'B.'

The mean hip extensor strength for group 'A' (average of right and left side) was 12.74 ± 0.73kg, whereas it was

Table 1. Basic characteristics of the study patients

Characters	Group A		Group B		Mann-Whitney ` U' test		
	M	S.D	M	S.D	U	Z	P
Age	26.33	3.15	26.32	3.34	792.50	0.07	0.942
BMI	22.51	2.40	23.45	2.76	655.50	1.39	0.164

M- Mean, SD- standard Deviation, 'U'- Mann Whitney value, Z- test statistics, P- probability.

Table 2. ASLR Score comparisons between groups

Outcome	Group A		Group B		Differences	Mann Whitney ` U' test		
	M	S.D	M	S.D		U	Z	P
ASLR	4.20	1.34	0.45	0.51	3.75 ± 0.79	0.000	7.89	0.001*

M- mean, SD- standard Deviation, 'U'- Mann Whitney value, Z- test statistics, P- probability, * - significant.

Table 3. Comparison of Lumbar lordosis and hip extensor strength between groups

Outcome measures	Group A		Group B		Difference	Paired sample test	
	M	S.D	M	S.D		f	P
Lumbar lordosis	64.27˚	2.28˚	48.81˚	7.23˚	15.46˚±6.91˚	12.91	0.001*
Hip Extensor in kgs:-						23.38	0.001*
Right	12.62	0.93	16.01	0.73	3.38 ± 1.23		
Left	12.85	1.00	15.99	0.56	3.14 ± 1.12		
Total (Rt/Lt)	12.74	0.73	16.00	0.50	3.26 ± 1.52		

M- mean, S.D- standard deviation, t- paired sample, P- probability, *- significant.

Table 4. Relative Risk (RR) and Odds Ratio (OR)

	Groups	Bad Outcomes	Good Outcomes	Total	Risk	odds	Relative Risk (RR)	Odd's ratio (OR)
4(a)								
Lumbard	GA	11	29	40	0.28	0.38	1.57	1.79
	GB	7	33	40	0.18	0.21		
4(b)								
RL	GA	22	18	40	0.55	1.22	2.75	4.89
	GB	8	32	40	0.2	0.25		
4 (c)								
LL	GA	18	22	40	0.45	0.82	3.6	5.73
	GB	5	35	40	0.125	0.14		

significantly higher in group 'B', M = 16.00 ± 0.50kg, t = 23.38, p = 0.001<0.05.

There is a complex relationship between OR and RR. Table 4 indicates the values of different event rates. OR is considered to be higher than RR when the value of RR is more than 1.0 (Tables 4a-c). When the value of OR is similar to RR, the value can be interchanged and the outcome is said to be rare (typically <10%), irrespective of whether the risk is higher (Table 4a) in the exposed group as compared to the unexposed. When the event rates increase, the values diverge and they cannot be interchanged.

The study showed that the mean lumbar lordosis was significantly higher for women with PGP than for those without PGP, p = 0.001. There was a 15.46° ± 6.91° higher angle was observed in persons who had pelvic girdle pain compared to those who did not have pelvic girdle pain. The mean hip extensor strength for group 'A' (average of right and left side) was 12.74 ± 0.73kg, whereas it was significantly higher in group 'B'.

5. Discussion

Musculoskeletal problems are common during postpartum. These problems are induced due to pregnancy hormones and physical changes that occur during pregnancy. Stress is placed on the spinal cord, pelvic girdle, and genital tract which gives rise to problems such as PGP, LBA, neurological compression, and joint disruption. This study aims at identifying the presence of PGP and to identify the association between lumbar lordosis and hip extensor strength with PGP. PGP is a pain that arises from the lumbosacral, sacroiliac and pubis symphysis joints. The pain is reproducible with provocation tests. PGP is known to affect the endurance capacity of women in walking and standing. It was reported that 63.8% of new mothers had decreased capacity for activity due to fatigue. Biomechanical changes in the posture such as an increase in lumbar curvature occur during pregnancy and some of the changes persist post-delivery. Studies have reported the presence of increased lumbar lordosis that persists up to 6 months postpartum. Low back pain and hip muscle weakness are also seen in postpartum due to incomplete recovery of abdominal muscles and impairment in neuromuscular control. Hence this study focuses on identifying lumbar lordosis and hip extensor strength as contributive factors to cause PGP.

The results show that women with PGP had reduced strength in hip extensor muscles than women without pelvic girdle pain.

A study has reported that reduced strength in the transverse abdominis, pelvic floor muscles, internal oblique, and poor coordination of the lumbopelvic muscles are the common reasons for pelvic girdle pain. Lee and colleagues,2008, the study showed that overuse of the buttock muscles and external oblique muscles and reduced strength in transverse abdominis increases the shear stress of the Sacroiliac Joint (SIJ) which causes pelvic girdle pain[23].

A case study done on postpartum runners has shown to cause LBA and hip pain and restriction in hip extension. The strength test showed weakness in the hamstring, gluteus medius, and gluteus maximus. This study showed that lumbar stabilization exercises and USI biofeedback were used to treat persons with hip pain and LBA. The exercises also proved to thicken the transverse abdominis, lower limb loading and pelvic control during running[24]. A study (Shefali) has shown that postpartum runners had strength impairments in hip extensors, hip abductors, pelvic floor muscles and abdominal muscles. Postpartum runners compensate on other structures for stability due to laxity. The study shows that Trendelenburg alignment results from hip muscle weakness and it has been studied for running injury risk. The study also reported alignment changes in the postpartum period such as dynamic knee valgus, increased lumbar lordosis, and thoracic kyphosis[25].

6. Recommendations

- Additional research is indicated to investigate women with regional obesity around the abdomen with lumbar lordosis.
- The dynamic strength of the hip extensors can be assessed.

7. Conclusion

The study concludes that there is a positive association between lumbar lordosis and hip extensor weakness in pelvic girdle pain.

8. References

1. Vleeming A, Albert HB, Östgaard HC, Sturesson B, Stuge B. European guidelines for the diagnosis and treatment of pelvic girdle pain. European Spine Journal. 2008; 17(6):794-819. https://doi.org/10.1007/s00586-008-0602-4 PMid:18259783 PMCid:PMC2518998
2. Wuytack F, Curtis E, Begley C. Experiences of first-time mothers with persistent pelvic girdle pain after childbirth: descriptive qualitative study. Physical Therapy. 2015 Oct 1; 95(10):1354-64. https://doi.org/10.2522/ptj.20150088 PMid:25929535
3. O'Sullivan PB, Beales DJ. Diagnosis and classification of pelvic girdle pain disorders- Part 1: A mechanism based approach within a biopsychosocial framework. Manual Therapy. 2007 May; 12(2):86-97 https://doi.org/10.1016/j.math.2007.02.001 PMid:17449432
4. Dufour S, Daniel S. Understanding clinical decision making: Pregnancy-related pelvic girdle pain. Journal of Women's Health Physical Therapy. 2018 Sep; 42(3):120-7 https://doi.org/10.1097/JWH.0000000000000100
5. Aldabe D, Milosavljevic S, Bussey MD. Is pregnancy related pelvic girdle pain associated with altered kinematic, kinetic and motor control of the pelvis? A systematic review. Eur Spine J. 2012 Sep; 21(9):1777-87. https://doi.org/10.1007/s00586-012-2401-1 PMid:22718046 PMCid:PMC3459120
6. Casagrande D, Gugala Z, Clark SM, Lindsey RW. Low back pain and pelvic girdle pain in pregnancy. Journal of the American Academy of Orthopaedic Surgeons. 2015 Sep; 23(9):539-49. https://doi.org/10.5435/JAAOS-D-14-00248 PMid:26271756
7. Zahedpour F, Mohammadi M, Damavandi M, Agah J. The effect of core stability training on postpartum lumbar lordosis and low back pain in nulliparous women. The Iranian Journal of Obstetrics, Gynecology and Infertility, 2017; 20(3):89-97. doi: 10.22038/ijogi.2017.8876
8. Lue Y, Hsieh C, Liu M, Hsiao S, Chen S, Lin J, *et al.* Influence of testing position on the reliability of hip extensor strength measured by a handheld dynamometer. The Kaohsiung Journal of Medical Sciences. 2009 Mar; 25(3):126-32. https://doi.org/10.1016/S1607-551X(09)70051-8 PMid:19419917
9. Smith JA, Popovich JM, Kulig K. The influence of hip strength on lower-limb, pelvis, and trunk kinematics and coordination patterns during walking and hopping in healthy women. J Orthop Sports Phys Ther. 2014 Jul; 44(7):525-31. https://doi.org/10.2519/jospt.2014.5028 PMid:24816500
10. Sjödahl J, Gutke A, Öberg B. Predictors for long-term disability in women with persistent postpartum pelvic girdle pain. Eur Spine J. 2013 Jul; 22(7):1665-73 https://doi.org/10.1007/s00586-013-2716-6 PMid:23430102 PMCid: PMC3698347
11. Gutke A, Östgaard H, Öberg B. Association between muscle function and low back pain in relation to pregnancy. J Rehabil Med. 2008; 40(4):304-11. https://doi.org/10.2340/16501977-0170 PMid:18382827
12. Morino S, Ishihara M, Umezaki F, Hatanaka H, Yamashita M, Aoyama T. Pelvic alignment changes during the perinatal

period. PLoS ONE. 2019 Oct 10; 14(10):e0223776. https://doi.org/10.1371/journal.pone.0223776 PMid:31600310 PMCid:PMC6799872

13. Ronchetti I, Vleeming A, van Wingerden JP. Physical characteristics of women with severe pelvic girdle pain after pregnancy. Spine. 2008 Mar; 33(5):E145-51. https://doi.org/10.1097/BRS.0b013e3181657f03 PMid:18317182
14. Robinson HS, Mengshoel AM, Bjelland EK, Vøllestad NK. Pelvic girdle pain, clinical tests and disability in late pregnancy. Manual Therapy. 2010 Jun; 15(3):280-5 https://doi.org/10.1016/j.math.2010.01.006 PMid:20117040
15. Mukkannavar P, Desai BR, Mohanty U, Kulkarni S, Parvatikar V, Daiwajna S. Pelvic girdle pain in Indian postpartum women: a cross-sectional study. Physiotherapy Theory and Practice. 2014 Feb; 30(2):123-30. https://doi.org/10.3109/09593985.2013.816399 PMid:23899351
16. Mens JMA, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. Spine. 2001 May; 26(10):1167-71. https://doi.org/10.1097/00007632-200105150-00015 PMid:11413432
17. Gutke A, Hansson ER, Zetherström G, Östgaard HC. Posterior pelvic pain provocation test is negative in patients with lumbar herniated discs. Eur Spine J. 2009 Jul; 18(7):1008-12. https://doi.org/10.1007/s00586-009-1003-z PMid:19390876 PMCid:PMC2899577
18. Ishøi L, Hölmich P, Thorborg K. Measures of hip muscle strength and rate of force development using a fixated handheld dynamometer: intra-tester intra-day reliability of a clinical set-up. Int J Sports Physther. 2019 Sep; 14(5):715-23. https://doi.org/10.26603/ijspt20190715 PMid:31598409 PMCid:PMC6769277
19. Lin JT, Lutz GE. Postpartum sacral fracture presenting as lumbar radiculopathy: A case report. Archives of Physical Medicine and Rehabilitation. 2004 Aug; 85(8):1358-61. https://doi.org/10.1016/j.apmr.2003.09.021 PMid:15295766
20. de Oliveira TS, Candotti CT, La Torre M, Pelinson PPT, Furlanetto TS, Kutchak FM, et al. Validity and reproducibility of the measurements obtained using the flexicurve instrument to evaluate the angles of thoracic and lumbar curvatures of the spine in the sagittal plane. Rehabilitation Research and Practice. 2012; 2012:1-9. https://doi.org/10.1155/2012/186156 PMid:22619723 PMCid:PMC3348664
21. Malmqvist S, Kjaermann I, Andersen K, Gausel AM, Økland I, Larsen JP, et al. Can a bothersome course of pelvic pain from mid-pregnancy to birth be predicted? A Norwegian prospective longitudinal SMS-Track study. BMJ Open. 2018 Jul; 8(7):e021378. https://doi.org/10.1136/bmjopen-2017-021378 PMid:30049694 PMCid:PMC6067360
22. R. Rajabi. Which method is accurate when using the flexible ruler to measure the lumbar curvature angle? Deep pint or mid point of arch? World Applied Sciences Journal. 2008; 4(6):849-52.
23. Verstraete EH, Vanderstraeten G, Parewijck W. Pelvic Girdle Pain during or after Pregnancy: a review of recent evidence and a clinical care path proposal. Facts Views Vis Obgyn. 2013; 5(1):33-43.
24. Thein-Nissenbaumjm, Thompsonef, Chumanov ES, Heiderscheit B. Low back and hip pain in a postpartum runner: Applying ultrasound imaging and running analysis. J Orthop Sports Physther. 2012 Jul; 42(7):615-24. https://doi.org/10.2519/jospt.2012.3941 PMid:22446476
25. Christophers M, Garcia AN, Snodgrasssj, Cook C. Common musculoskeletal impairments in postpartum runners: An international delphi study. Arch Physiother. 2020 Dec;10(1). https://doi.org/10.1186/s40945-020-00090-y PMid:33117595 PMCid:PMC7586674