ORIGINAL ARTICLE

EFFECTS OF MUSCLE ENERGY TECHNIQUE AND POSTURAL CORRECTION EXERCISES IN LORDOTIC FEMALES WEARING HIGH HEELS; A QUASI EXPERIMENTAL TRIAL

Nosheen Manzoor[1], Muhammad Salman Bashir[2], Rabiya Noor[3], Farah Shaheen[4]

ABSTRACT

Introduction: Low back pain is one of the most common ailments for which patients seek physiotherapy treatment. Pelvic tilting becomes evident when the mechanical causes of low back pain are identified. In such cases, the iliopsoas muscle plays a crucial role in managing LBP. Since it is often contracted, stretching the muscle can help alleviate the condition. There is a correlation between lumbar lordosis and pelvic inclination in females who wear high-heeled shoes. The purpose of this study was to determine the effects of Muscle Energy Technique (MET) and Postural Correction Exercises on low back pain in females wearing high heels.

Material & Methods: A total of 28 females, aged 18–45 years, who wore high-heeled shoes for six hours per day and presented with low back pain and an increased lumbosacral angle without radiating symptoms, were randomly divided into two groups. Patients in the treatment group received Muscle Energy Techniques (METs), while those in the control group performed posture correction exercises. Functional disability and pain were assessed using the Modified Oswestry Low Back Pain Disability Questionnaire and the Pain Numeric Rating Scale. Data analysis was conducted using SPSS version 16.0. An independent t-test was used to compare changes between groups, while a paired t-test was used to assess changes within each group.

Results: There was no significant difference at baseline ($p > 0.05$), indicating that both groups were homogeneous at the time of recruitment. However, the post-treatment p-value ($p < 0.05$) showed a significant reduction in pain and disability levels in patients treated with MET. Additionally, lumbar range of motion (ROM) demonstrated statistically significant improvement in pelvic tilt angle, flexion, and extension in the MET group ($p < 0.05$), while both groups showed significant improvements in side-flexion and rotation ROM ($p < 0.05$).

Conclusion: MET is more effective in treating lordotic posture. Patients in the MET group experienced greater reductions in pain and disability, along with improved range of motion, compared to those performing postural correction exercises.

Keywords: Lordosis, METs, Postural Correction Exercise

Authors' Declaration: The authors declared no conflict of interest and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed substantially to the planning of research, question designing, data collection, data analysis and write-up of the article.

Authors' Affiliation

[1]Assistant Professor, University of Management and Technology, Lahore

[2]Professor, University of Management and Technology, Lahore

[3]Professor, Riphah International University, Lahore

[4]HOD Physiotherapy, Shalamar Hospital, Lahore

Corresponding Author

Nosheen Manzoor

Assistant Professor, University of Management and Technology, Lahore

Email: nosheenmanzoor@umt.edu.pk

This article may be cited as: Manzoor N, Bashir MS, Noor R, Shaheen F. Effects of muscle energy technique and postural correction exercises in lordotic females wearing high heels; a quasi-experimental trial. Rehman J Health Sci. 2024;6(2). 213-220

Submitted: Apr 05, 2024 Revisions Submitted: May 24, 2024 Accepted: Dec 24, 2024

INTRODUCTION

Most low back pain sufferers (between 85% and 90%) are classed as having non-specific low back pain. (NSLBP).[1] Long-lasting low back pain has been linked to issues with

lumbar spine posture and movement control.[2,3] Patients with LBP exhibit a markedly diminished capacity to actively control their low back's mobility compared to healthy participants.[4] Significant deviations from the optimal posture have negative effects on muscular performance and increases the risk of developing a number of ailments associated with poor posture.[5] It has been stated that sustained poor posture causes a individuals' muscles to become unbalanced, causing one side of the muscles to shorten and the other side to extend.[5,6] The tendency to wear high-heeled shoes is a common contributing factor to postural alterations among individuals today. This habit has been reported to influence postural patterns significantly. According to surveys, approximately 37% of Americans and 78% of Britons regularly wear high heels. Additionally, about 58% of females experience low back pain due to high-heel use.[7] Any deviation from the pelvis' neutral position triggers compensatory movements in various body parts, with the lumbar spine being the most affected segment.[8]

Numerous investigations have discovered a link between lumbar lordosis and low back pain. In 13 trials, 927 students without low back pain and 796 patients with low back pain were identified. Low back pain and decreased lumbar lordotic angle have been observed to be strongly correlated among individuals of the same age groups.[9] The biomechanical effects observed with the use of three different heel heights are decrease in trunk flexion angle, increase in muscular activity of tibialis anterior and low back studied by EMG while walking with high heeled shoes.[10] Low back pain has also been linked to high-heeled footwear (LBP). Therapists and medical professionals have warned that wearing high heels can exacerbate lumber lordosis and increase curvature, both of which can cause low back pain.[10,11,12]

Back health experts believe that spinal control and stability are important for back health.[13,14] Although various exercise methods have been emphasized to promote spinal stability, no single approach has been consistently proven superior.[15-17] It has been stated that exercises help correct muscle imbalances while simultaneously realigning bony structures, leading to improved posture.[18]

Besides conservative techniques, several fundamental treatments exist for managing severe low back pain. One of the most recent methods for addressing somatic dysfunction is the Muscle Energy Technique (MET). MET is a dynamic approach in which the patient actively contributes to the treatment process rather than relying solely on the provider. According to Greenman, MET involves the patient exerting approximately 20% effort while the therapist applies the technique in a controlled manner. Additionally, MET enhances the physiological function of the affected region by lengthening shortened muscles and improving the range of motion and mobility of surrounding structures.[19-20]

Another study explored the use of Muscle Energy Techniques (MET) to enhance the gross trunk range of motion. The usage of Muscle Energy Techniques has helped to extend the range of rotational movement. The study was conducted on fifty-nine volunteers, who were divided into control and treatment groups. Results showed a significant increase in trunk rotation in the treatment group following a single treatment session. According to this study, MET is an effective approach for managing spinal dysfunctions.[21-22]

A review of the literature on this topic indicates that manual therapy is highly effective in reducing low back pain associated with lordosis. However, various manual therapy techniques have been proposed for managing lordotic posture. There is limited information on the effectiveness of Muscle Energy Techniques (METs) in treating back pain caused by lordosis, as only a few case studies have examined their impact. The aim of this study was to analyze the effects of METs in comparison to conventional approaches for correcting lordotic posture caused by high

heels. Specifically, the study focuses on evaluating METs effectiveness in alleviating pain, increasing lumbar range of motion, and maintaining pelvic tilt.

MATERIAL AND METHODS

This Quasi Experimental trial took place in the Department of Physical Therapy at Riphah International University Faisalabad Campus. This study was approved by the Riphah International University Ethical Review Committee. The study was conducted from April to September 2019, following ethical approval from the Riphah College of Rehabilitation & Allied Health Sciences Research Ethical Committee (Ref. No. REC/RCRS/18/1003).

The patients were recruited by a physical therapist at the university hospital. Each patient provided written informed consent, which outlined the trial's safety measures and their right to withdraw at any time. The sample size of 28 was determined using a 10% attrition rate, 80% statistical power, a 5% margin of error, and a 95% confidence interval.

A total of 28 females aged 18 to 45 years were included in the study. Participants met the following criteria: low back pain lasting no more than 12 weeks, wearing 4- to 5-inch high-heeled shoes for at least 6 hours a day, an initial Oswestry Disability Index (ODI) score of 20% to 60%, and localized lumbar spine pain without radiating symptoms to the buttocks, hips, or legs.

Patients were excluded if they did not meet the age requirements or presented with red flags such as tumors, fractures, metabolic diseases, rheumatoid arthritis, osteoporosis, resting blood pressure exceeding 140/90 mmHg, prolonged steroid use, or nerve compression symptoms (e.g., radiating pain, sensory changes, significant muscle weakness, hypo-reflexia, or hyper-reflexia). Other exclusion criteria included lumbar spinal stenosis, lumbar spondylolisthesis, or any neurological deficits.

The included patients were randomly assigned to the control group, which received posture correction exercises and the treatment group, which received Muscle Energy Techniques (METs). Both groups received posture education as a baseline treatment. A manual therapist administered the therapeutic interventions.

Control group:

The control group received postural correction exercises, which included both stretching and strengthening activities. The hip extensors and abdominal muscles were strengthened, while the hip flexors and back extensors were stretched. Back extensors were stretched using seated hip flexion, and hip flexors were stretched in a lunge position. Abdominal muscles were strengthened through curl-up exercises, while resisted contractions in a prone position were used to strengthen the hip extensors. These exercises were performed three times per week for a total duration of four weeks.

Treatment group:

The treatment group received the Post-Isometric Relaxation (PIR) technique as part of Muscle Energy Techniques (METs). MET was applied to two key muscle groups: the hip flexors (Iliopsoas) and lumbar extensors (Erector Spinae). Patients were instructed to position the target muscle appropriately, apply 20% isometric force, and hold the contraction for 7 to 10 seconds. Afterward, they relaxed for a few seconds. As the patient exhaled, the therapist moved the muscle to a new limitation barrier and held the position for three repetitions of 30 seconds as an end-stretch.

Both interventions were applied three days per week for a total duration of four weeks.

Outcome Measure:

Numeric Pain Rating Scale

The eleven-point numeric pain rating scale is used to assess patients' pain levels. A score of 0 represents no pain, while 11 represents the worst possible pain. The Intraclass Correlation Coefficient (ICC) for NPRS is 0.76, and the minimal clinically important difference (MCID) ranges from 2.1 to 4.3.[23]

Modified Oswestry Disability Index:

It is a validated tool for assessing disability in patients with low back pain (LBP). It consists of ten components covering various functional activities. Each item is scored from

0 to 5, with higher scores indicating greater disability.[24] MODI assesses pain intensity, lifting, sitting, standing, walking, sleeping, personal hygiene, social life, travel, and work/homemaking (replacing the "sex life" category from the original Oswestry Disability Index (ODI)). An ICC >0.70 indicates good reliability, while an ICC <0.70 suggests moderate to poor reliability. Correlation values between 0.35 and 0.67 are considered mild to moderate, 0.68 to 0.89 are strong, and 0.90 or higher indicates extremely high correlation.[25]

Universal Goniometer

A Universal Goniometer (UG) with 10-inch moving arms and a 360-degree goniometer face made of plastic was used to measure the range of motion (ROM).[26]

ICC values interpretation:

Outstanding reliability: ICC >0.75

Moderate-to-good reliability: ICC 0.4 – 0.75

Poor reliability: ICC <0.4

Measurements:

Baseline measurements were recorded before the intervention and again at six months post-treatment. All assessments were performed by skilled, highly qualified staff who were not involved in the interventions and were blinded to group allocation.

The Modified Oswestry Low Back Pain Disability Questionnaire (ODI) and the Numerical Pain Rating Scale (NPRS) were used to measure the subjective data. Pelvic inclinometer was used to measure anterior pelvic tilt angle, and universal goniometer was used to check the lumbar ROM. Descriptive statistic were showed by multiple bar charts, frequency tables, and histograms. The improvement across groups was demonstrated using the independent t-test, and the improvement within groups was demonstrated using the paired t-test.

Analysis of Statistics:

All statistical analyses were conducted using SPSS Statistics version 22.0, with $P < 0.05$ set as the significance level. Data normality was checked using the Shapiro-Wilk test.

For descriptive statistics, means and standard deviations were calculated. Graphical representations included pie charts, bar charts, and frequency tables for descriptive statistics. Paired T-tests analyzed within-group improvements.

Independent T-tests compared between-group improvements in both subjective and objective metrics across consecutive visits.

RESULTS

A total of twenty-eight patients meeting the inclusion criteria were recruited. The mean age of the MET group was 26.6 ± 3.87 years, while the postural correction exercise group had a mean age of 23.57 ± 5.72 years. The mean height of the MET group was 5.31 ± 0.23 meters, whereas the postural correction exercise group had a mean height of 5.26 ± 0.12 meters.

These results compare the anterior pelvic tilt angle pre- and post-treatment within each group. The mean improvement in the MET group was 3.07, compared to 1.21 in the postural correction exercise group, indicating greater clinical significance in the MET group. At the time of recruitment, both groups were homogeneous, with no significant difference at baseline (p>0.05) (Table 1).

Table 1: Normality of Data

		Muscle Energy Technique	Postural Correction Exercises	P-value
		Mean ± SD	Mean ± SD	
Numeric pain rating scale score		6.78±0.892	7.42±0.851	0.062
Disability index score		14.27 ± 2.61	14.09 ± 2.66	0.87
Anterior Pelvic Tilt Angle		13.42±1.69	15.28±2.127	0.170
Lumbar functional mobility	Flexion	36.28±3.911	31.78± 5.33	0.170
	Extension	42.50± 2.59	44.42±3.81	0.130
	Right rotation	10.50±2.21	9.78±1.67	0.344
	Left rotation	10.57±2.13	12.64±2.43	0.469

Pain reduction was significantly greater in the MET-treated group, with a P value < 0.05. The mean improvement in the MET group was 3.87, compared to 2.072 in the postural correction

exercise group, indicating greater clinical significance in the MET group (Table 2).
To determine whether there was a significant change in lumbar flexion and extension range of motion before and after treatment, an independent sample t-test was performed. The results, with a P value < 0.05, indicated a statistically significant difference between the two groups(Tables3&4).

Table 2: Between Group Comparison of Pelvic Tilt

Study Groups		Mean ± SD	P value
Muscle Energy Technique	Pre-Treatment Ant. Pelvic Tilt	13.42 ± 1.69	0.170
Postural Correction Exercises		15.28 ± 2.12	
Muscle Energy Technique	Post-Treatment Ant. Pelvic Tilt	10.35 ± 1.54	0.000
Postural Correction Exercises		14.07 ± 1.49	

Table 3: Between Group Comparison of Flexion ROM

Study Groups		Mean ± SD	P value
Muscle Energy Technique	Pre-Treatment Lumbar Flexion	36.28 ± 3.91	0.170
Postural Correction Exercises		31.78 ± 5.33	
Muscle Energy Technique	Post-Treatment Lumbar Flexion	40.14 ± 3.69	0.000
Postural Correction Exercises		32.35 ± 5.07	

Table 4: Between Group Comparison of Extension ROM

Study Groups		Mean ± SD	P value
Muscle Energy Technique (	Pre-Treatment Lumbar Extension	42.50 ± 2.59	0.130
Postural Correction Exercises		44.42 ± 3.81	
Muscle Energy Technique	Post-Treatment Lumbar Extension	36.42 ± 3.39	0.043
Postural Correction Exercises		42.57 ± 4.60	

DISCUSSION

The current study's objective was to evaluate the efficacy of Muscle Energy Technique (MET) in treating patients with persistent, nonspecific low back pain. A total of twenty-eight patients were randomly assigned to two groups: one received Postural Correction Exercises (PCE) along with postural education, while the other received MET along with postural education. The findings of this study suggests that MET provides significant benefits in managing persistent, generalized low back pain. The most remarkable improvements were observed in the MET group, with considerable reductions in pain and disability post-intervention, as demonstrated by group comparisons. While the postural correction exercise group also showed positive outcomes, the MET group exhibited a more substantial impact. This study demonstrated significant pain relief in the MET group, with a pre-treatment mean of 6.786 and a post-treatment mean of 2.929. In comparison, the postural correction exercise group had a pre-treatment mean of 7.429 and a post-treatment mean of 5.357. In contrast to these findings, Hume Kendall and Jenkins' studies concluded that workouts that include lumbar isometric flexion are much more effective than those that involve back extensions. They included the same number of experimental patients in their trial but provided no patient data. They might have studied something outside of our field of expertise.

A comparison of pre- and post-treatment values between the postural correction exercise group and the Muscle Energy Technique (MET) group revealed that the MET group exhibited greater improvement in anterior pelvic tilt angle. An eight-week study was conducted to examine the effects of a combination of exercises on lumbar lordosis angle and pain. The study included female individuals with sciatica, and the findings indicated that a combination of exercises effectively reduced both the lumbar lordosis angle and pain. These results align with findings from Farzam, Greene et al., and Hamill et al., who also reported similar

positive outcomes with exercise interventions for managing lumbar lordosis.[27-29]

The study's findings also revealed a significant difference in the Flexion and Extension range of motion between the group receiving MET and the group receiving posture correction activities. These findings were in line with those of a prior study, which found that isometric flexion exercises were beneficial in cases of elevated lumbar lordosis. However, no supporting evidence could be located. This statistical significance may have been attained in a study including a sizable population due to minor variations in the treatment groups. However, assessments of pain and spinal flexion were shown to be better in all three treatment groups. Additionally, 50% of the patients who experienced total pain relief were able to resume their regular daily activities following the study duration. Therefore, none of the exercise regimen had a significant impact on total recovery as compared to SWD alone.[30]

Carter et al. (2002) examined the impact of stretching exercises and concluded that corrective exercises could effectively reduce thoracic kyphosis and lumbar lordosis by improving spinal alignment.[31]

Clinical Relevance of the Study:

This study compared the efficacy of postural correction exercises and Muscle Energy Techniques (MET) in treating women who wear high heels and experience low back pain. Given that low back pain is a prevalent issue, the findings provide valuable insights into managing symptoms in this population.

The results indicated statistically significant improvements in pain intensity and range of motion in patients treated with MET, demonstrating its effectiveness in correcting lordotic posture and alleviating low back pain. These findings highlight the potential clinical usefulness of MET. Therefore, physical therapists should be trained in this technique, as it contributes to holistic functional improvement in patients.

Limitations:

One limitation of this study was that patients' daily activities were not documented, which may have influenced their low back pain symptoms during the treatment protocol.

Recommendations:

A larger sample size should be recruited to assess long-term effects of MET beyond the study period. Future studies should differentiate between acute and chronic cases of low back pain. Patient follow-up should be incorporated to evaluate sustained outcomes of MET over time.

CONCLUSION

The Muscle Energy Technique (MET), applied over a six-month period, proved to be effective in reducing pain and disability associated with lordotic posture caused by high heels. Participants who received MET combined with Posture Education showed greater improvements compared to those who underwent Postural Correction Exercises with Posture Education.

REFERENCES

1. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2012;380(9859):2163-96.

2. Pijnenburg M, Caeyenberghs K, Janssens L, Goossens N, Swinnen SP, Sunaert S, et al. Microstructural integrity of the superior cerebellar peduncle is associated with an impaired proprioceptive weighting capacity in individuals with non-specific low back pain. PLoS One. 2014;9(6):100666.

3. Hadizadeh M, Mousavi SJ, Sedaghatnejad E, Talebian S, Parnianpour M. The effect of chronic low back pain on trunk accuracy in a multidirectional isometric tracking task. Spine. 2014;39(26):1608-E15.

4. Luomajoki H, Kool J, De Bruin ED, Airaksinen O. Movement control tests of the low back; evaluation of the difference between patients with low back pain and healthy controls. BMC musculoskeletal disorders. 2008;9(1):1-12.

5. Novak CB, Mackinnon SE. Repetitive use and static postures: a source of nerve compression and pain. Journal of hand therapy. 1997;10(2):151-9.

6. Bloomfield J. Postural considerations in

sport performance. Applied Anatomy and Biomechanics in Sport. 1994;43(2):95-109.
7. Baaklini E, Angst M, Schellenberg F, Hitz M, Schmid S, Tal A, et al. High-heeled walking decreases lumbar lordosis. Gait Posture. 2017; 55:12-4.
8. Opila KA, Wagner SS, Schiowitz S, Chen J. Postural alignment in barefoot and high-heeled stance. Spine. 1988;13(5):542-7.
9. Chun S-W, Lim C-Y, Kim K, Hwang J, Chung SG. The relationship between low back pain and lumbar lordosis: a systematic review and meta-analysis. The Spine Journal. 2017;17(8):1180-91.
10. Lee C-M, Jeong E-H, Freivalds A. Biomechanical effects of wearing high-heeled shoes. International journal of industrial ergonomics. 2001;28(6):321-6.
11. Bendix T, Sørensen SS, Klausen K. Lumbar curve, trunk muscles, and line of gravity with different heel heights. Spine. 1984;9(2):223-7.
12. Franklin ME, Chenier TC, Brauninger L, Cook H, Harris S. Effect of positive heel inclination on posture. J Orthop Sports Phys Ther. 1995;21(2):94-9.
13. Panjabi MM. Clinical spinal instability and low back pain. Journal of electromyography and kinesiology. 2003;13(4):371-9.
14. Macedo LG, Maher CG, Latimer J, McAuley JH. Motor control exercise for persistent, nonspecific low back pain: a systematic review. Physical therapy. 2009;89(1):9-25.
15. Choi B, Verbeek J, Tam W, Jiang J. Choi, Brian KL, ed." Exercises for prevention of recurrences of low-back pain. Cochrane Database of Systematic Reviews. 2010;1.
16. Cairns MC, Foster NE, Wright C. Randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain. LWW; 2006.
17. Koumantakis GA, Watson PJ, Oldham JA. Supplementation of general endurance exercise with stabilisation training versus general exercise only: physiological and functional outcomes of a randomised controlled trial of patients with recurrent low back pain. Clinical biomechanics. 2005;20(5):474-82.
18. Hrysomallis C, Goodman C. A review of resistance exercise and posture realignment. The Journal of Strength & Conditioning Research. 2001;15(3):385-90.
19. DeRosa CP, Porterfield JA. A physical therapy model for the treatment of low back pain. Phys Ther. 1992;72(4):261-9.
20. Greenman P. Principles of manual therapy. Baltimore, MD: Williams & Wilkins; 1996.
21. Lenehan KL, Fryer G, McLaughlin P. The effect of muscle energy technique on gross trunk range of motion. Journal of osteopathic medicine. 2003;6(1):13-8.
22. Afzal F, Manzoor S. Prolong wearing high heeled shoes can cause low back pain. J Nov Physiother. 2017;7(356):2.
23. Young IA, Dunning J, Butts R, Mourad F, Cleland JAJPt, practice. Reliability, construct validity, and responsiveness of the neck disability index and numeric pain rating scale in patients with mechanical neck pain without upper extremity symptoms. 2019;35(12):1328-35.
24. Shafshak TS, Elnemr RJJJoCR. The visual analogue scale versus numerical rating scale in measuring pain severity and predicting disability in low back pain. 2021;27(7):282-5.
25. Denteneer L, Van Daele U, Truijen S, De Hertogh W, Meirte J, Deckers K, et al. The modified low back pain disability questionnaire: reliability, validity, and responsiveness of a Dutch language version. 2018;43(5):292-E8.
26. Alawna MA, Unver BH, Yuksel EOJJotapma. The reliability of a smartphone goniometer application compared with a traditional goniometer for measuring ankle joint range of motion. 2019;109(1):22-9.
27. Farzam F. Effects of corrective exercise on relative improvement on lumbar lordosis of Kermanian students aged between 14-17 year. Persian Msc Thesis, University of Tehran. 1995.
28. Greene DP, Roberts SL. Kinesiology-E-Book: Movement in the Context of Activity: Elsevier Health Sciences; 2015.

29. Hamill J, Knutzen KM. Biomechanical basis of human movement: Lippincott Williams & Wilkins; 2006.
30. Davies J, Gibson T, Tester L. The value of exercises in the treatment of low back pain. Rheumatology. 1979;18(4):243-8.
31. Carter ND, Khan KM, McKay HA, Petit MA, Waterman C, Heinonen A, et al. Community-based exercise program reduces risk factors for falls in 65-to 75-year-old women with osteoporosis: randomized controlled trial. Cmaj. 2002;167(9):997-1004.