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Effect of Quadrupedal Movement Training on Physical Fitness and Functional Performance in Non - Specific Low Back Pain Patients

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Abstract: ***Background: Non - specific low back pain (NSLBP) is a frequently encountered musculoskeletal condition characterized by lower back pain and discomfort that is not associated with a particular disease or anatomical origin. A complex interaction of variables, including poor posture, sprained ligaments, muscle strain, and aging itself, frequently leads to NSLBP. Over time, the lumbar spine experiences wear and tear, and non - specific low back pain can become more uncomfortable due to injuries or abuse of its components. Hip function, core strength, and low back pain are strongly correlated. The relationships between these domains are essential for preserving spinal stability and general musculoskeletal health. One of the most important aspects of treating and preventing low back pain is addressing the connection between the hip and core muscles. Exercises aimed at enhancing hip mobility, building overall musculoskeletal health, and strengthening the core are frequently included in comprehensive methods to rehabilitation. People who have chronic low back pain should see physiotherapists or medical specialists for a customized evaluation and focused treatment. Aim & Objectives: To study the effect of quadrupedal movement training on pain, flexibility, spinal mobility, balance, and functional performance on the patients of subacute and chronic non - specific low back pain. Method: A total of 51 participants were selected as per the inclusion and exclusion criteria. Outcomes measures Visual Analogue Scale, Sit and Reach, Modified Schober's Test, Fingertip - To - Floor Distance Test, modified Oswestry Disability Index and Y - balance Test were taken pre and post week 2 and week 4 for both the groups. Result: The results were analyzed using SPSS software version 29. The analysis was done using paired t test for intra group analysis. There is a significant change statistically between the pre, post week 2 and week 4 values of Visual Analogue Scale, Sit and Reach, Modified Schober's Test, Fingertip - To - Floor Distance Test, modified Oswestry Disability Index and Y - balance Test, obtained post quadrupedal movement training with a p value < 0.001. Conclusion: This study suggests that quadrupedal movement training helps in improving the physical fitness and functional performance in patients with sub - acute and chronic non - specific low back pain.***

Keywords: Non - specific Low Back Pain, Quadrupedal movement training, Animal Flow

1. Introduction

According to the European Guidelines for Prevention of Low Back Pain, back pain is defined as "pain and discomfort, located below the costal margin and above the inferior gluteal folds, with or without leg pain. " The most common kind of low back pain is non - specific low back pain.[1]

The intricate structure of the lower back is made up of a complex interplay of parts, including the lumbar spine, facet joints, intervertebral discs, muscles, ligaments, and nerves. The lumbar spine's intricate anatomy provides the flexibility and support required to carry out a range of duties, but it also leaves it open to various pressures that may result in the development of NSLBP. Over time, the lumbar spine experiences wear and tear, and non - specific low back pain can become more uncomfortable due to injuries or abuse of its components. This illness can cause a variety of symptoms, including as stiffness, decreased range of motion, and dull or severe pain, all of which can have a substantial negative influence on a person's everyday activities and general quality of life.

Around the world, low back pain is a serious issue and the main reason for years lost to disability.2 s Every year, LBP affects 9–17% of the world's population, and its prevalence is rising. Approximately 90% of low back pain diagnosed are non - specific in origin.3 Research indicates that up to 23% of people globally suffer from chronic low pain. In this group, there was a recurrence incidence of 24% to 80% within a year.4 According to standard definitions, low back pain is classified as acute if it lasts less than six weeks, subacute when it lasts between six and twelve weeks, and chronic when it lasts longer than twelve weeks.[5]

The core muscles, including the deep abdominal muscles - transverse abdominis, the obliques, give the spine its necessary stability. Increased strain the lower back may be result from weakness in these muscles. The hip flexors and glutes, particularly the gluteus medius and maximus, are two muscles that surround the hips and help support the spine. Low back pain can be exacerbated by alteration in pelvic alignment, which is affected by imbalance or weakness in hip musculature. Hip and core muscles work in coordination. Compensatory behaviour in one area may result from dysfunction in another. For instance, tense hip flexors might make it more difficult for the core muscles to contract, which can compromise spinal stability. Thus, one of the most important aspects of treating and preventing low back pain is addressing the connection between the hip and core muscles. Quadrupedal movements are those in which the body is moved with the use of all four limbs. They get their name from the term "quadrupeds, " which refers to four - legged animals. It is an excellent approach to employ body weight as

resistance and may be performed in different planes of motion.[6]

Exercises with quadrupled legs entail maintaining the spine in a neutral posture while the trunk is loaded using an array of methods, such as shifting the upper and lower limbs into different positions or standing still while raising the pelvis off the ground against gravity. For example, bounds, crawls, tabletops, walks, etc. These motions can be executed in a variety of planes, such as rotation, side - to - side, and forward/backward. This kind of exercise helps to maintain good alignment and posture while enhancing core strength, balance, stability, and mobility.[7]

Currently, several commercially available QMT systems exist including, Ground Force Method, Ginastica Natural, Original Strength, MovNat, and Animal Flow (AF).7 In this study we will look more into the effects of Animal Flow. AF is a novel form of QMT consisting of dynamic quadrupedal movements that are practiced, sequenced with other movements, and eventually choreographed into a flow, a series of AF movements linked together. Like other commercial QMT systems, the AF system claims to improve flexibility, range of motion, balance, and endurance; however, these claims have not been substantiated.

Aim

To study the effect of quadrupedal movement training on the patients of subacute and chronic non - specific low back pain.

2. Objective

1) To study the effect of quadrupedal movement training on pain using VAS.
2) To study the effect of quadrupedal movement training on flexibility using Sit and Reach Test.
3) To study the effect of quadrupedal movement training on Spinal Mobility using modified Schober's Test for lumbar flexion and extension; fingertip to floor Test for lumbar lateral flexion.
4) To study the effect of quadrupedal movement training on balance using Y Balance Test.
5) To study the effect of quadrupedal movement training on functional performance using Modified Oswestry Disability Index.

3. Methodology

- Study design – Analytical Study
- Study type - Interventional Study
- Sampling method – cluster sampling
- Study Duration – 1 year
- Duration of data collection - 6 months
- Sampling calculation - using GPower - 42
- Sample Size – 51
- Study population – Patients with sub - acute or chronic non - specific low back pain.

Inclusion Criteria

1) Patients with sub - acute and chronic non - specific low back pain of the age group 18 - 30 years.
2) Patients with VAS <5.

Exclusion Criteria

1) Any recent fracture
2) Radiculopathy
3) Acute low back pain
4) Ankylosing spondylitis
5) History of spinal surgery
6) Neurological and psychiatric disease
7) Pregnancy

4. Procedure

This was an Interventional study conducted on sub - acute and chronic non - specific low back pain patients. An ethical approval was obtained from the institutional ethical committee. Participants were selected as per the inclusion and exclusion criteria. They were explained about the rationale of the study. A signed informed consent was taken from the participants included in the study. Participants were assessed with outcome measures which included Visual Analogue Scale, Sit and Reach, Modified Schober's Test, Fingertip - To - Floor Distance Test, modified Oswestry Disability Index and Y - balance test.51 participants participated in this study and was selected using cluster sampling method. Structured exercise regimen for 4 weeks (3 sessions a week). A 10 minute of warm up protocol was given to optimize the muscle function. Participants were given the quadrupedal movement training for 30 minutes, thrice a week for 4 weeks with 7 - 10 minutes of warm - up exercises before starting the intervention and cool down for 5 minutes after the intervention Outcome measures were re assessed after week 2 and after week 4.

5. Results

The current study was conducted to investigate the effects of quadrupedal movement training on patients with sub - acute and chronic low - back pain. A total of 49 patients were evaluated. The mean age of Group was 24.78±3.05 years. The paired t test was used for intragroup analysis of pre and post week 2 and week 4 treatment analysis of group, values of $p < 0.01$ were considered significant. All the outcome measures were statistically significant for both post week 2 and week 4.

6. Discussion

This group consisted of total 51 subjects out of these 25 were males and 24 were females. The mean age of the participants was 24.78±3.05. Age of these participants range from 18 years to 30 years. Group A VAS (on activity) reduced from 3.72±0.83 to 1.62±0.81 at the end of week 2 and 0.52±0.61 at the end of 4th week and p <.001 which was statistically significant. It has been theorized that exercise may reduce back pain through a process of neurological or physiologic desensitization of the pain producing tissue, through the repeated application of force or stress to that tissue.8 Muscle contractions activate A - delta and C fibres in skeletal muscle, the stimulation of which can lead to the activation of the endogenous opioid system. Koltyn et al proposed the most tested hypothesis for EIH (Exercise induced hypoalgesia) is that exercise induces a release of endogenous opioids at either peripheral, spinal, and/or central sites: all of which contribute to pain modulation through the gate theory by Melzack and Wall and redefine the pain thresholds and tolerance levels.9

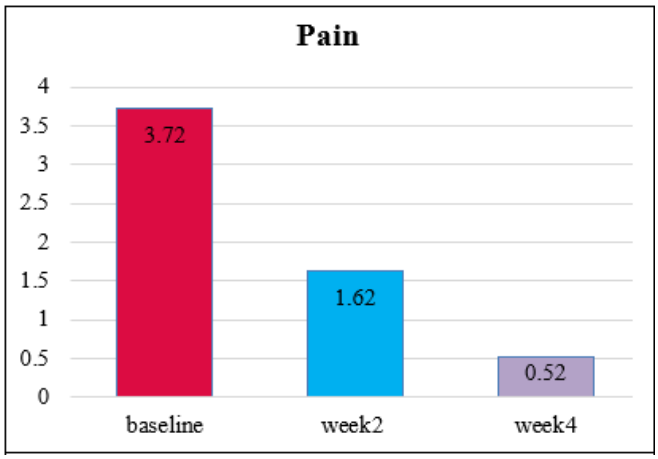
Flexibility improved from - 1.84±1.93 to 0.39±1.76 at the end of week 2 and 2.30±1.54 at the end of 4th week and p <.001 which was statistically significant. The improvement in Lumbar mobility can be attributed to the benefits obtained by stretching of muscles. stretching and exercise can improve muscle extensibility, or the ability of muscles to lengthen. This is achieved by breaking down adhesions between muscle fibres and increasing blood flow to the muscles, which promotes tissue remodelling and increased flexibility.[10] Stretching of a muscle fibre begins with the sarcomere. As the sarcomere contracts, the area of overlap between the thick and thin myofilaments increases. As it stretches, this area of overlap decreases, allowing the muscle fibre to elongate. Therefore, when the muscle is stretched, the muscle fibre is pulled out to its full - length sarcomere by sarcomere, and then the connective tissue takes up the remaining slack. When this occurs, it helps to realign any disorganized fibres in the direction of the tension. The more the fibres that are stretched, the greater the length developed by the stretched muscle. This increase in muscle length resulted in an improvement in ROM which could be otherwise limited due to shortened muscles.[11] Group showed more improvement, reason for which could be mainly that dynamic flexibility in QMT group was seen to be improved because one component of QMT describes 'Form specific stretches of joint' in the workout, end range movement involved in forms such as Loaded beast, Wave load and unload and Scorpion reach. Based on this principle it is noted that QMT helps to stretch the entire body and it is thus designed to build flexibility. Loaded Beast or Wave Load - Unload in QMT helps increase the flexibility of posterior muscles as well as the fascia. The improvements in flexibility seen in our study are consistent with existing literature by Jeffrey D. Buxton[12] showing improvement in terms of flexibility as many of the QMT intervention exercises were performed with the hips and shoulders at or near end ranges. These movements provided a combined passive and active stretching stimulus, both of which have been shown to improve extensibility.

Relevant changes in modified Oswestry disability index (MODI) were seen post 6 sessions and 12 sessions. It improved from 14.76±3.20 to 9.56±2.60 at the end of week 2 and 4.34±1.81at the end of 4th week and p <.001 which was statistically significant. Post intervention changes in pain intensity, walking, travelling components of ODI demonstrated improvement in 6 sessions. In QMT the participant is learning the innovative forms and flows for the very first time and because of an emergent property of our nervous systems, which is called self - organization the movements are learned and new patterns are registered, this concentration in learning of new movements allows participant for a goal - oriented practice and consistent exposure to novel movement challenges.

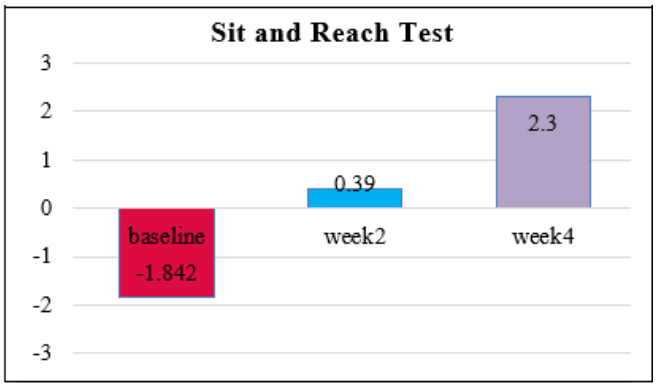
Improvement in Lumbar mobility was also noted. Lumbar forward flexion improved from 36.58±3.61 to 41.22±3.05 at the end of week 2 and 48.60±2.22 at the end of 4th week. Lumbar extension improved from 10.32±1.72 to 14.38±1.55 at the end of week 2 and 19.46±0.68 at the end of 4th week. Lumbar lateral flexion on left side improved from 14.42±1.97 to 20.94±1.74 at the end of week 2 and 27.14±2.02 at the end of 4th week. Lumbar lateral flexion on right side improved from 14.12±1.84 to 19.74±1.65 at the end of week 2 and 25.56±2.02 at the end of 4th week and p<.001 for all the components hence showing statistically significant result. This is achieved by breaking down adhesions between muscle fibres and increasing blood flow to the muscles, which promotes tissue remodelling and increased flexibility. The muscles of the lower back, including the erector spinae, multifidus, and other core muscles, provide support and stability to the lumbar spine. Strengthening these muscles through exercise can help improve overall lumbar mobility and reduce the risk of injury.[13, 14]

This change can be attributed to Psoas muscle which is a paraspinal muscle located deep in the body, and attaches to the lumbar spine and the hip joint, which is a major player in this relationship. It originates from Vertebral bodies of T12 - L4, intervertebral discs between T12 - L4, transverse processes of L1 - L5 vertebrae and inserts on Lesser trochanter of femur as iliopsoas tendon. It is a vital muscle that plays a critical role in many important functions of the body, including movement and stability. Also, Hip rotator strengthening exercises can have a positive effect on lumbar mobility, as the muscles of the hips and lumbar spine are closely connected and work together to provide stability and movement. When the hip rotator muscles are weak, the body may compensate by tightening the muscles in the lumbar spine, which can lead to decreased mobility and increased risk of injury. Strengthening the hip rotator muscles can help to balance out this relationship and allow for better movement and stability in the lumbar spine. Additionally, hip rotator strengthening exercises can improve overall hip function and flexibility, which can also contribute to improved lumbar mobility.[15]

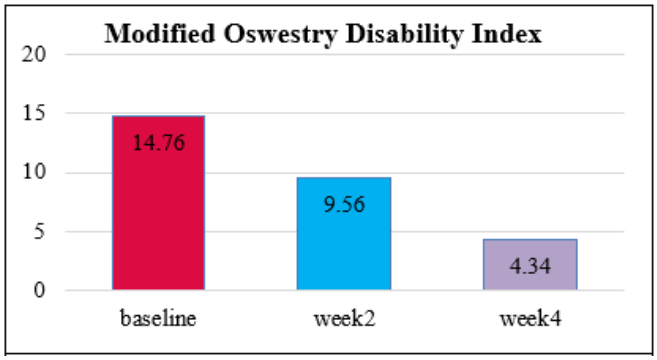
There was a statistically significant improvement in post intervention values of Dynamic Balance assessed using Y balance test. The values change was seen from 79.83±6.69 to 83.76±6.40 at the end of week 2 and 88.06±7.04 at the end of 4th week and p<.001. Dynamic balance is required when your body is in motion and mostly mimics real life situations, such as walking. Body balance control is a complex body function that involves regulating posture and movement via the cerebellum by processing sensory inputs from the vestibular visual and proprioceptive systems in the cerebral cortex. Muscle weakness, along with pain and reduced proprioceptive inputs reduces the balance. There is statistically significant improvement in the QMT intervention group because of the most common in all vertebrates are autonomous neural circuits called central program generators (CPGs), which are believed to be evolutionarily derived. CPGs control the coupling of the arms and legs giving rise to bipedal and quadrupedal locomotion patterns in humans and animals, respectively. Human motor development is often referred to as the progressive "head - to - tail" development of sensory perception leading to postural control, object manipulation, and locomotion, It is imperative that adding complex movements in quadrupedal movement training along with change in the surface and dynamics brings about improvements in the bipedal balance, joint position sense and proprioception in dynamic balance.



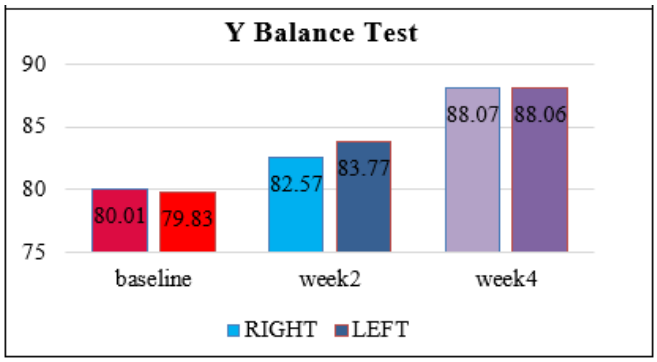
Graph 1: Pre, post week 2 and post week 4 of VAS on Activity



Graph 2: Pre, post week 2 and post week 4 of Sit and Reach Test



Graph 3: Pre, post week 2 and post week 4 for Modified Oswestry Disability Index



Graph 4: Pre, post week 2 and post week 4 for Y Balance Test

7. Conclusion

The study concluded that within group analysis showed statistically significant improvement in all the outcome measures. Participants who performed Quadrupedal Movement Training showed more significant improvement in flexibility, pain, lumbar range of motions, functional performances, and dynamic balance.

8. Limitation

- The intervention was carried on for 4 weeks, but
- since it is a novel and challenging fitness program it takes time for the participant to cope - up. Longer duration of intervention could yield better training effects.
- The long - term effects of QMT are yet unknown.
- Adherence ratio in interventions is not clear.

9. Future Scope of Study

- Future research could explore Since QMT has been proved to be beneficial, the effects of QMT can be compared with conventional protocol.
- The effects of QMT can be compared with moderate to vigorous exercise regimes like Pilates, Functional training, and Aerobic Exercises.
- Different physical components can be assessed in future studies such as Agility, Cognitive function, and Proprioception.

References

[1] Burton AK, Balagué F, Cardon G, et al. Chapter 2. European guidelines for prevention in low back pain`: November 2004. Eur Spine J.2006; 15 Suppl 2 (Suppl 2): S136 - S168. doi: 10.1007/s00586 - 006 - 1070 - 3

[2] Cohen, L. Menezes Costa, P. Croft, M. Ferreira, P. H. Ferreira, J. M. Fritz, S. Genevay, D. P. Gross, M. J. Hancock, D. Hoy, J. Karppinen, B. W. Koes, A. Kongsted, Q. Louw, B. Öberg, W. C. Peul, G. Pransky, M. Schoene, J. Sieper, R. J. Smeets, J. A. Turner, A. Woolf

[3] James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, Abbastabar H, Abd - Allah F, Abdela J, Abdelalim A, Abdollahpour I. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet.2018 Nov 10; 392 (10159): 1789 - 858.

[4] O'Sullivan P. Diagnosis and classification of chronic low back pain disorders: maladaptive movement and motor control impairments as underlying mechanism. Man Ther 2005; 10 (4): 242 - 55.

[5] Ahmed, Usman Abba et al. 'The Effect of Muscles Energy Technique in the Management of Chronic Mechanical Low Back Pain: A Scoping Review'.1 Jan.2021: 179 – 193

[6] Pyka DT. Effects of static, stationary, and traveling trunk exercises on muscle activation. California State University, Fullerton; 2017

[7] Bagherian S, Ghasempoor K, Rahnama N, Wikstrom EA. The effect of core stability training on functional

movement patterns in college athletes. Journal of sport rehabilitation.2019 Jul 1; 28 (5): 444 - 9.

[8] Rainville, James, et al. "Exercise as a treatment for chronic low back pain. " The Spine Journal 4.1 (2004): 106 - 115.

[9] Koltyn KF, Brellenthin AG, Cook DB, Sehgal N, Hillard C. Mechanisms of exercise - induced hypoalgesia. J Pain.2014 Dec; 15 (12): 1294 - 1304. Doi: 10.1016/j. jpain.2014.09.006. PMID: 25261342; PMCID: PMC4302052.

[10] Bandy, W. D., & Irion, J. M. (1994). The effect of time on static stretch on the flexibility of the hamstring muscles. Physical Therapy, 74 (9), 845 - 850. doi: 10.1093/ptj/74.9.845

[11] Panjabi, M. M. (1992). The stabilizing system of the spine. Part I. Function, dysfunction, adaptation, and enhancement. Journal of Spinal Disorders, 5 (4), 383 - 389. doi: 10.1097/00002517 - 199212000 - 00001

[12] Cibulka MT. Low back pain and its relation to the hip and foot. Journal of Orthopaedic & Sports Physical Therapy.1999 Oct; 29 (10): 595 - 601.

[13] Jeffrey D. Buxton. The Effects of a Novel Quadrupedal Movement Training Program on Functional Movement, Range of Motion, Muscular Strength, and Endurance. The Journal of Strength and Conditioning Research. (2020); 36 (8): 2186–2193.

[14] Cibulka MT. Low back pain and its relation to the hip and foot. Journal of Orthopaedic & Sports Physical Therapy.1999 Oct; 29 (10): 595 - 601.