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Effect Of Quadrupedal Movement Training On Posture Of Long Standing Physiotherapists

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Abstract:
Background*: Physiotherapists are often exposed to prolonged standing and repetitive postural strain that contribute to muscle fatigue, venous pooling, mechanical stress on joints and soft tissues thereby predisposing them to work-related musculoskeletal disorders (WMSDs). Quadrupedal Movement Training (QMT) is a bodyweight-based intervention that may improve posture and musculoskeletal endurance through closed-chain, neuromuscular engagement. This study investigates the effect of QMT on postural alignment in physiotherapists subjected to extended standing.*
Materials and Methods*: An interventional study was conducted on 44 physiotherapists with more than two years of experience and standing over six hours per day. Participants underwent a 4-week QMT intervention comprising three 30-minute sessions per week. Pre- and post-intervention assessments included Tragus-to-Wall Distance (TWD), Cubital Angle, Q Angle, and Spinal Deviations (Kyphotic and Lordotic Angles) using validated tools like the Flexi Ruler and Goniometer. Statistical analysis was performed using paired t-tests with significance set at $p<0.05$.*
Results*: The study demonstrated statistically significant improvements in all postural parameters post-intervention. QMT reduced forward head posture, spinal curvature deviations, and joint misalignments, suggesting its potential as a preventive strategy against WMSDs in physiotherapists. Integration of QMT into workplace wellness programs could enhance postural control and occupational health outcomes.*
Key Word: *Quadrupedal Movement Training, Physiotherapists, Postural Alignment, Musculoskeletal Disorders, Prolonged Standing, Core Stability*

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I. Introduction

Physiotherapists often work in highly demanding physical environments that expose them to repetitive stress, awkward postures, and prolonged standing, all of which significantly increase the risk of developing work-related musculoskeletal disorders (WMSDs). Studies show that a majority of physiotherapists experience symptoms such as low back pain, neck strain, and upper limb disorders due to the physical nature of their job, with the prevalence of WMSDs reported between 58% to 91%. Lower back pain, neck stiffness, shoulder strain, and wrist discomfort are some of the most common issues. The underlying cause often lies in postural fatigue, overuse, and lack of awareness of biomechanical alignment during routine clinical tasks.

Posture, although involuntary and often taken for granted, plays a key role in maintaining musculoskeletal balance. It is regulated by the central nervous system through continuous feedback from the visual, vestibular, and somatosensory systems. These inputs help the body stay in equilibrium, both in static and dynamic positions. However, long hours of standing and repetitive patient handling can overload these systems, leading to microtrauma, muscle fatigue, and eventual structural issues. Even small, continuous postural adjustments — known as postural sway — are demanding for the body over time and may contribute to chronic discomfort.

In light of these challenges, alternative forms of movement like Quadrupedal Movement Training (QMT) have gained attention. QMT is a bodyweight-based system that focuses on ground-based movements using both hands and feet for support. Exercises such as Static Beast, Loaded Beast, and Crab Reach emphasize core activation, joint stability, and dynamic coordination. These movements are performed in a closed kinetic chain, which enhances proprioceptive feedback and joint control. What makes QMT particularly relevant for physiotherapists is that it mimics the weight shifts, stabilization, and multi-directional movements required in daily clinical tasks — but in a controlled and safe environment.

QMT has been shown to improve movement quality, strength, and postural control. It engages deep stabilizer muscles, promotes spinal alignment, and challenges balance, making it a valuable addition to injury

prevention and physical conditioning routines. For physiotherapists exposed to daily postural stress, integrating QMT into their self-care routines may offer a practical and effective way to enhance physical resilience and reduce the risk of long-term musculoskeletal strain.

II. Material And Methods

An interventional study was conducted at Nanavati Super Speciality Hospital, Mumbai, in 2024. The study was registered with CTRI (CTRI/2025/02/081032) and received ethical clearance (BNH/0599/2024).A total of 44 subjects participated in the study.

Study Design: An interventional study was conducted at Nanavati Super Speciality Hospital, Mumbai, in 2024. The study was registered with CTRI (CTRI/2025/02/081032) and received ethical clearance (BNH/0599/2024).

Study Location: The study was conducted at Nanavati Super Speciality Hospital, Mumbai, in 2024.

Study Duration: 1 Year

Subjects and Selection: physiotherapists were recruited through convenience sampling

Sample size: 44

Inclusion criteria

- Minimum two years of professional experience
- Standing for over six hours/day
- REBA score >9

Exclusion criteria

Any recent fractures, radiculopathy, acute low back pain, spinal surgery, neurological/psychiatric disorders, and pregnancy.

Intervention: Participants received QMT sessions thrice weekly for four weeks. Each session lasted 30 minutes and included static holds and dynamic flows using Animal Flow techniques. Progression from basic to complex movements occurred over the 4-week period.

Outcome Measures:

1. Tragus-to-Wall Distance (TWD)
2. Cubital Angle (Goniometer)
3. Q Angle (Goniometer)
4. Kyphotic and Lordotic Angles (Flexi Ruler)

Procedure methodology

a. Outcome Measures

1. Tragus-to-Wall Distance (TWD): **:**It provides an objective measure of head positioning relative to the thoracic spine. **:**In individuals with Ankylosing Spondylitis (AS), test-retest correlations have been reported between 0.93 and 0.95. For healthy younger and older adults, test-retest reliability ICCs ranged from 0.853 to 0.862.
2. Cubital Angle (Goniometer): The primary objective of measuring the cubital angle is to assess the anatomical alignment of the elbow joint with intra-class correlation coefficients (ICC) ranging from 0.945 to 0.973.
3. Q Angle (Goniometer): The objective of measuring Q angle is to assess the alignment of the knee joint. High intra-rater reliability is achievable with standardized protocols. For trained clinicians, intraclass correlation coefficients (ICC) range from 0.77–0.94, with standard error of measurement (SEM) $\leq 1.0°$
4. Kyphotic and Lordotic Angles (Flexi Ruler): Spinal posture is assessed using flexiruler to assess the kyphotic and the lordotic angle of the spine. Strong and significant correlations were demonstrated for both thoracic ($r = 0.72$, $P < 0.01$) and lumbar ($r = 0.60$, $P < 0.01$) curvatures.For thoracolumbar length measurements, studies report intraclass correlation coefficients (ICC) as high as 0.93, indicating excellent repeatability when the same examiner performs repeated assessments.

b. Intervention Protocol

Participants received QMT sessions thrice weekly for four weeks. Each session lasted 30 minutes and included static holds and dynamic flows using Animal Flow techniques. Progression from basic to complex movements occurred over the 4-week period.

Statistical analysis

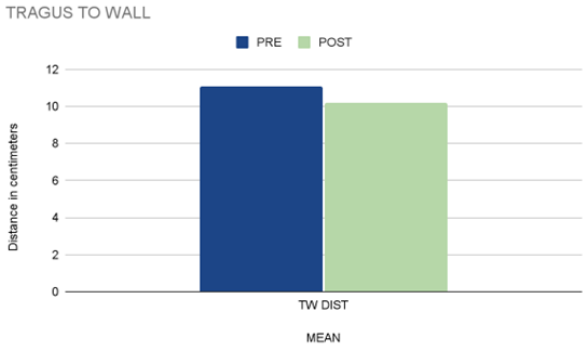
Paired t-tests were applied to compare pre- and post-intervention values using SPSS v30. Significance was determined at $p<0.05$.

III. Result

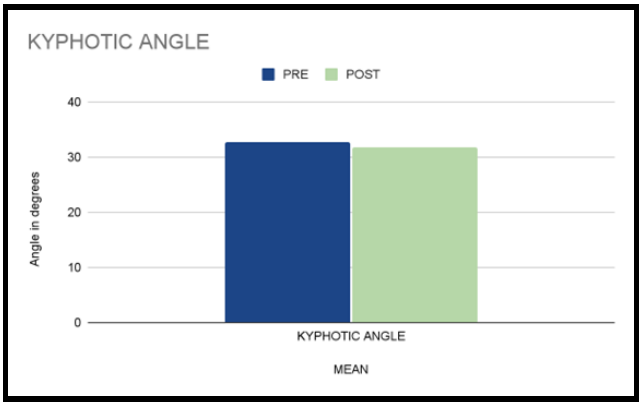
Participant Demographics: Of the 44 participants, 12 were male and 32 female, with a mean age of 26.13 ± 3.02 years and BMI of 25.64 ± 4.48. Over 50% were overweight or obese, indicating a need for physical activity interventions.

Postural Parameters:

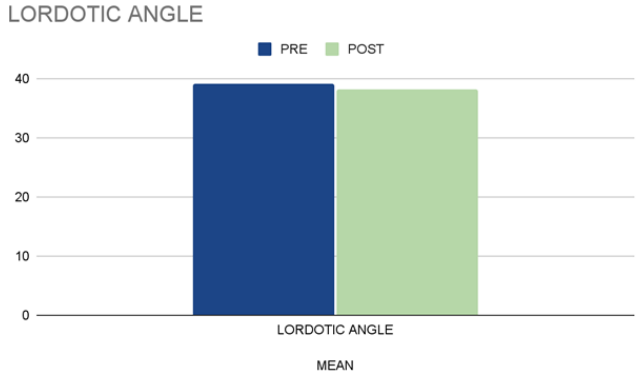
Tragus-to-Wall Distance: Reduced from 11.10 ± 1.24 cm to 10.19 ± 1.24 cm ($p<0.01$), reflecting improvement in forward head posture due to deep cervical flexor engagement and scapular stabilization.



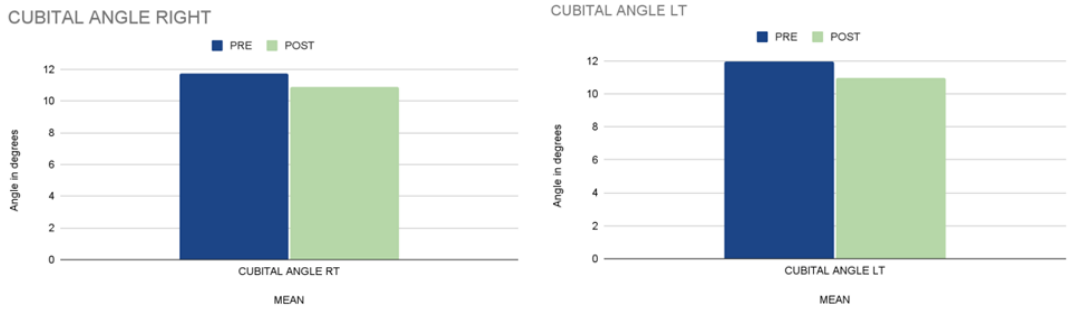
Kyphotic Angle: Decreased from 32.61 ± 5.04° to 31.78 ± 5.21° ($p<0.01$), indicating reduced thoracic flexion and enhanced extensor muscle endurance.



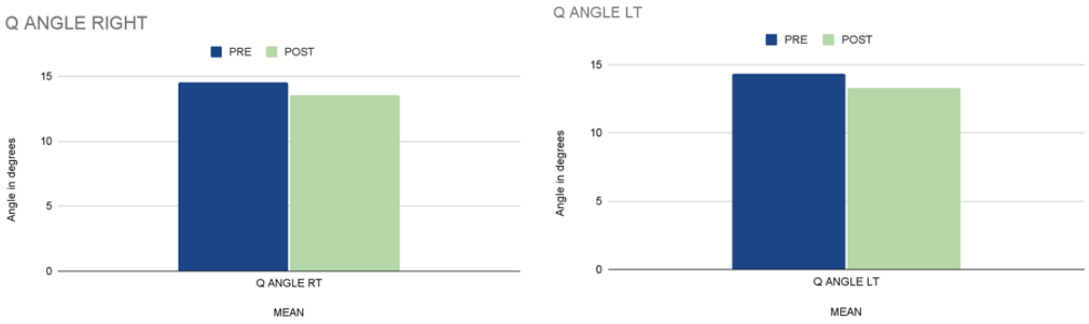
Lordotic Angle: Reduced from 39.07 ± 6.11° to 38.10 ± 5.70° ($p<0.01$), showing improved lumbo-pelvic stability due to core muscle co-contraction.



Cubital Angle: Right arm decreased from 11.73 ± 2.64° to 10.89 ± 2.26°; left arm from 11.98 ± 2.26° to 10.94 ± 2.28° (both $p<0.01$), due to neuromuscular activation under closed-chain loading.



Q Angle: Right side reduced from 14.49 ± 2.40° to 13.55 ± 2.33°; left from 14.30 ± 2.62° to 13.26 ± 2.67° ($p<0.01$), likely due to gluteal and hip stabilizer strengthening.



These findings align with previous studies demonstrating that QMT improves dynamic balance, spinal alignment, and neuromuscular control. The reduction in all parameters supports the utility of QMT as a preventive and rehabilitative strategy for postural dysfunctions in clinical professionals.

IV. Discussion

This study included 44 physiotherapists (12 males, 32 females; mean age 26.13 ± 3.02), with an average BMI of 25.64 ± 4.48, indicating that over half were overweight or obese. Despite working in a health-focused profession, many physiotherapists tend to neglect their own fitness, likely due to long working hours, prolonged standing, and physically demanding tasks, leading to a relatively sedentary lifestyle. Graphs show that 52.3% of the participants fall outside the normal BMI range. High BMI has been associated with altered biomechanics, such as increased Q angle and a tendency toward genu valgum. Additionally, obesity correlates with reduced muscle mass and increased spinal loading, contributing to lumbar spine issues and joint degeneration. These structural and functional changes can affect not just joints but also the surrounding tissues and receptors. Quadrupedal Movement Training (QMT), categorized as moderate-intensity by ACSM, offers a potential solution by improving strength, flexibility, and cardiovascular health simultaneously.

Tragus to wall Distance:

There was a notable reduction in the tragus-to-wall distance, reflecting improved cervical spine alignment, likely due to enhanced co-activation of the neck flexors, extensors, and scapular stabilizers. Exercises like Beast Hold or Loaded Beast require neutral cervical alignment against gravity. This position demands isometric co-contraction of deep cervical flexors **(**longus colli, capitis) and extensors (semispinalis cervicis, splenius capitis) to maintain head position against gravitational pull and resist excessive flexion/extension due to upper limb loading.

Through constant repetition of quadrupedal movements in Animal Flow, the postural muscles particularly the deep neck flexors, thoracic extensors, and scapular stabilizers are consistently engaged to maintain head and spinal alignment against gravity. This constant activation improves muscular endurance by enhancing oxidative capacity, blood flow, and neuromuscular efficiency, allowing these muscles to sustain activity over longer periods without fatigue. At the same time, proprioceptors located in muscles and joint capsules, especially around the atlanto-occipital and cervico-thoracic regions, provide continuous feedback to

the central nervous system about head and neck positioning. This feedback loop strengthens joint position sense and improves the body's awareness of alignment. Static beast also improves Scapular stabilization through the serratus anterior and lower trapezius may reduce thoracic kyphosis, influencing cervical spine alignment.

A Study in 2016 by Im B et. al. showed that scapular stabilization exercises improved the cervical spine posture. The researchers recruited a total of 15 patients with neck pain. The Cranio-vertebral angle increased significantly in the experimental group (from 38.7 to 49.3) after training compared to the control group (from 40.7 to 41.0) ($p<0.05$). This change in the cranio-vertebral angle promotes proper posture of the cervical spine. That promotes axial loading through the upper extremities and encourages neuromuscular activation of postural stabilizers, which may contribute to improved head and neck positioning.

Spinal curvature

For change in the kyphotic angle, Exercises like static crab, activated crab (single limb lift) fire muscles like upper trapezius ,lower trapezius , rhomboids and deltoid muscles and exercises like loaded beast, crab reach stretches out the anterior and anterior oblique chains while improving the eccentric control of the extension chain. These exercises require the participants to maintain the static and dynamic balance in which center of gravity is maintained in equilibrium to anatomical structures and the weight of the body is distributed throughout the skeletal system. In addition, the muscular system uses antagonistic isometric contractions that determine postural tone, responsible for improving posture. Beast reach helps in activating transversus abdominis and multifidus during dynamic limb, also this movement involves lifting the hips and extending the spine. This co-contraction of abdominal muscles during spinal movements improved the spinal stability which in turn helped to reduce the excessive lordotic curve. Loaded Beast enhanced intra-abdominal pressure for spinal unloading. Under-switch Taps activated the smaller and deeper muscles like multifidus that stabilizes the spine while this movement involves pivoting and rotating, hence activating deeper and smaller muscles like multifidus which improved the segmental stabilization of spine during rotation and pivoting. Form specific stretches loaded the spine eccentrically in crab reach and scorpion reach, loaded the spine concentrically in beast reach. While performing these exercises collectively in a set pattern there is increased activation of latissimus dorsi and erector spinae is achieved which in-turn counteracts the thoracic flexion dominance.

In 2024 a study by Buxton et. al. Twenty (males $n = 9$) participants (age: 27.5 ± 10.8 yrs, height: 169.0 ± 7.0 cm, mass: 66.6 ± 10.9 kg) were prepped and fitted with sEMG electrodes on their right-side bicep brachii, medial deltoid, triceps brachii, pectoralis major, latissimus dorsi, rectus abdominus, rectus femoris and bicep femoris. Following completion of maximal voluntary isometric contraction (MVIC) tests for normalization, participants performed 4 repetitions of 8 QMT exercises (from the Animal Flow™ system) and 3 TRA exercises (pushup, squat and forearm plank) in random order. The pooled peak muscle activations of all QMT exercises resulted in moderate (21–40% MVIC) to very high (>60% MVIC) peak muscle activation levels for each muscle group with significantly higher ($p > 0.05$) muscle activation for the biceps ($47.72 \pm 21.41\%$), deltoid ($66.58 \pm 11.39\%$), and latissimus dorsi ($62.81 \pm 18.14\%$) than the pushup (23.31 ± 16.95, 45.63 ± 18.59, $29.17 \pm 20.58\%$ respectively) and significantly higher activation of the bicep femoris ($41.89 \pm 13.83\%$) than the squat ($17.79 \pm 11.12\%$). TRA (pushup) showed significantly higher activation of the triceps and pectoralis.

Cubital Angle

Animal flow exercises involve weight bearing through the upper limbs, promoting eccentric and concentric contractions of the elbow flexors and extensors. Dynamic elbow stabilizers confer stability through the

activation of various muscles that cross the elbow. Increased activation of the forearm musculature, particularly the flexor-pronator group, may contribute to dynamic stabilization of the elbow joint(22). The quadrupedal position of Activated Beast placed the elbow joint under axial compression. There was co-contraction of the triceps, flexor pronator mass, and brachioradialis that maintained stability, reducing excessive valgus stress on the elbow. Prolonged isometric activation of these muscles increased the ligamentous tension around the medial and lateral elbow structures, influencing dynamic control of the cubital angle over time. Serratus anterior and rotator cuff activation further enhances scapular stability, which indirectly affects the elbow's kinetic chain control. Beast walk, the locomotive movement requires reciprocal loading of the elbows, emphasizing flexion-extension cycles under weight-bearing conditions. With each step forward, the supporting elbow experiences increased compressive force, requiring dynamic stabilization from the flexor-pronator group. The continuous shifting of load between the elbows challenges joint proprioception, improving neuromuscular coordination of the elbow flexors and extensors. Activation of the brachialis and biceps brachii help maintain control of the flexed elbow, while triceps activation ensures proper extension without excessive valgus deviation. In Activated Crab, the posterior chain supports the body defying gravity , which demands eccentric control of triceps in order to maintain extension at the elbow. To counteract hyperextension at elbow brachialis and biceps contract concentrically. The forearm supinators and flexors work to stabilize the elbow, reducing

excessive valgus strain. Sustained static load on the elbows in a partially extended position could contribute to adaptive changes in ligament tension, influencing elbow alignment over time.

Q- Angle

The closed kinetic chain movements in animal flow training enhance quadriceps co-contraction, particularly targeting the vastus medialis obliqus and lateral musculature. Improved neuromuscular control to reduce the valgus collapse, which influenced the Q angle magnitude over time. Increased hip and core engagement in these exercises may alter pelvic alignment, indirectly modulating femoral internal rotation and tibial positioning, both of which contribute to Q angle variations. Ape Reach, a deep squat-to-reach motion improves hip mobility, external rotation, and glute activation.Gluteus medius and maximus activation counteracts excessive femoral internal rotation, which can contribute to an increased Q angle.The hip abductors work to stabilize the pelvis, preventing excessive medial knee collapse. Crab walk, a reverse quadrupedal movement, strengthens the posterior chain, particularly the gluteus maximus, hamstrings, and core stabilizers. Stronger hip extensors and abductors help maintain proper knee alignment by reducing femoral adduction and internal rotation, which contribute to a larger Q angle. The dynamic stabilization of the knee joint during weight shifts reinforces proper quadriceps tracking, reducing excessive lateral patellar displacement.

Scorpion reach requires hip extension, abduction, and rotation, which target gluteus maximus, medius, and deep hip stabilizers. By improving hip stability and control, it prevents excessive medial knee collapse, counteracting dynamic valgus stress that contributes to a larger Q angle. The movement also improves core engagement and pelvic alignment, which are key in maintaining optimal knee biomechanics. Underswitch performed was a transitional movement that required single-leg stability and lower limb coordination. Another study, “Quadrupedal movement training improves markers of cognition and joint repositioning,” (Matthews et al, 2016) found the following conclusion: Performance of a novel, progressive, and challenging task, requiring the coordination of all 4 limbs, has a beneficial impact on cognitive flexibility, and in joint reposition sense, although only at the specific joint angle directly targeted by the training. The findings are consistent with other studies showing improvements in executive function and joint reposition sense following physical activity.The hip abductors, adductors, and quadriceps must work synergistically to maintain proper knee alignment during movement shifts. By reinforcing hip-knee-ankle proprioception, this movement helps optimize Q angle positioning through improved neuromuscular control.

V. Conclusion

The study titled "Effect of Quadrupedal Movement Training on Posture of Long-Standing Physiotherapists" aimed to evaluate the impact of Quadrupedal Movement Training (QMT) on postural parameters in physiotherapists who engage in prolonged standing. The findings indicate statistically significant improvements in postural alignment, spinal curvature, and joint positioning, suggesting that QMT may serve as an effective intervention for postural correction and musculoskeletal health maintenance in this population.

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