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Impact of Lower Limb Flexibility and its Correlation with Low Back Pain in Contemporary Dancers: A Cross-Sectional Study

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Abstract: ***Background: Contemporary dance places high demands on flexibility, strength, and endurance, often leading to low back pain (LBP) due to repetitive movements. While lower limb flexibility is crucial for injury prevention, its specific relationship with LBP in dancers is underexplored. This study aims to assess the impact of lower limb flexibility on LBP prevalence and severity in contemporary dancers. Methodology: This quantitative observational cross-sectional study assesses the impact of lower limb flexibility on low back pain (LBP) in contemporary dancers aged 18-35 years with at least 2 years of experience and 5 hours of practice weekly. A sample of 40 dancers will undergo flexibility assessments (Sit-and-Reach and Quadriceps Test), and LBP will be evaluated using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI). Inclusion criteria include dancers experiencing pain, while those with chronic musculoskeletal conditions, recent injuries, or other dance forms are excluded. Results: This study found a significant positive correlation between hamstring flexibility and pain severity, suggesting that better hamstring flexibility may reduce low back pain (LBP) in contemporary dancers. However, quadriceps flexibility did not significantly affect pain severity or disability levels. Conclusion: Improved hamstring flexibility appears to reduce LBP severity, highlighting the importance of flexibility training in dancers.***

Keywords: Low Back Pain, Contemporary Dancers, Flexibility, Oswestry Disability Index, Visual Analogue Scale

1. Introduction

Dance is an activity that integrates multiple senses, connects movement to music, and allows self-expression while involving various aspects of personality [(1)]. As with any athlete, dancers have a high risk of injury. Contemporary dancers frequently perform repetitive extensions, twisting, and bending movements, placing them at increased risk for low back pain (LBP). Of all dance-related injuries, 60-80% occur in the lower limbs and 17-30% in the spine, with studies reporting a high one-year incidence of LBP among dancers [(2)].

LBP is a leading cause of disability worldwide, affecting physical, psychological, social, and economic well-being [(3)]. It may arise from abnormal spinal loading, posture disturbances, psychosocial factors, and decreased hamstring length. Reduced hamstring flexibility limits lumbar flexion and pelvic tilt, altering lumbar biomechanics and contributing to LBP [(4,5)].

Hip flexor tightness also influences lumbar stability. Muscles such as the iliacus, psoas, pectineus, rectus femoris, and sartorius play key roles in maintaining lumbar-pelvic control. Excessive tightness decreases hip extension ROM and is associated with isometric trunk weakness and LBP, affecting performance [(3)]. In dancers, repetitive movements in hypermobile ranges and uncontrolled pelvic-lumbar motions further contribute to LBP development. Conditions such as spondylosis and spondylolisthesis are more common in dancers due to repetitive overload [(2)].

Contemporary dance demands high flexibility, mobility, and strength, making dancers vulnerable to musculoskeletal injuries, especially in the lower back, hips, knees, and ankles [(6)]. Physical and emotional demands may worsen pain, reduce participation, and increase the risk of chronic injury [(7)]. Literature highlights a lack of medical guidance in dance schools, resulting in under-recognition of injuries [(8)]. Despite the high prevalence of LBP in dancers, few studies have examined back complaints in this population, and only limited research has explored the role of lower limb flexibility [(2,11,12)].

Flexibility contributes to aesthetic lines and extreme hip and spine ROM in contemporary dance; however, most supplementary training focuses on strength and endurance rather than active ROM [(10)]. Given the repetitive and high-impact movements in contemporary dance, understanding how lower limb flexibility relates to LBP can help guide effective injury prevention and management strategies. This cross-sectional study aims to evaluate the impact of lower limb flexibility on LBP severity and disability in contemporary dancers and to explore correlations between flexibility parameters and LBP intensity. The findings may assist instructors and healthcare professionals in developing targeted interventions to enhance performance and reduce injury risk.

2. Need of the Study

Contemporary dancers experience a high prevalence of lower extremity injuries and LBP, which can significantly affect

performance and career longevity. Flexibility is essential for efficient movement and proper technique, while deficits in flexibility can alter biomechanics, increase muscle tension, and elevate injury risk. Despite its importance, limited research exists on the relationship between lower limb flexibility and LBP among contemporary dancers. This gap highlights the necessity of studying how flexibility influences LBP severity, disability, and overall musculoskeletal health in this population.

3. Aims and Objectives

Aims

1) To evaluate the impact of lower limb flexibility on the severity and disability levels associated with low back pain (LBP) in contemporary dancers.
2) To explore the correlation between lower limb flexibility and the intensity of LBP in contemporary dancers.

Objectives

1) To assess lower limb flexibility in contemporary dancers using standardized flexibility tests.
2) To determine the severity and disability impact of LBP using validated pain scales/questionnaires.
3) To analyze correlations between lower limb flexibility parameters and LBP severity and disability levels.

4. Literature Survey

1) **Wenying Sun et al. (2020)** examined injuries in contemporary dance, focusing on modern dance. They found ankle, knee, and shin injuries are common and emphasized strategies for reducing injury risk and promoting a healthy dance career.
2) **Alexandros Makegoods et al. (2011)** highlighted that musculoskeletal injuries are prevalent in contemporary dancers, primarily affecting the lower limbs, including hip, knee, ankle, and foot.
3) **Yiannis Koutedakis et al. (2005)** emphasized the importance of muscular strength in dancers. Traditional dance-only training may compromise strength and joint integrity, while targeted strength training enhances performance, reduces injury risk, and supports resilience without affecting aesthetics.
4) **N. Rousell et al. (2012)** compared dancers with and without a history of LBP. Dancers with LBP showed poorer lumbopelvic motor control, though muscle extensibility and joint hypermobility were similar.
5) **H Day & Yiannis Koutedakis (2011)** reviewed hypermobility in dancers, noting it can cause altered proprioception, increased pain perception, and musculoskeletal disorders, emphasizing the need for targeted interventions and refined diagnostic criteria.
6) **Jamie Misegades et al. (2020)** found that limited mobility, poor core stability, and insufficient flexibility in key muscles like hamstrings, hip flexors, and lumbar extensors contribute to LBP, recommending interventions to improve flexibility and postural control.
7) **Isabel Komeroski et al. (2016)** studied beginner jazz dancers and found that a three-month contemporary dance program significantly improved strength and flexibility, particularly hip flexion, abduction, and spinal extension.
8) **P Sneha Balakrishnan et al.** analyzed 9 studies (2000–2023) on LBP in dancers, identifying repetitive movements, poor posture, inadequate core strength, and excessive flexibility as major risk factors, and emphasized early rehabilitation and injury prevention strategies.
9) **Manuela Angio et al. (2009)** investigated fitness in contemporary dancers and reported that supplementary exercise training improves aerobic/anaerobic fitness, muscular strength, and performance, highlighting the need for structured training programs.
10) **Yiannis Koutedakis et al. (2009)** discussed muscular strength in dancers, noting that reduced strength, poor aerobic fitness, and biomechanical factors increase injury severity, especially in the lower back and knee for contemporary dancers.

5. Methodology

Study Design

This **quantitative observational study** used a **cross-sectional design** to assess the impact of lower limb flexibility on low back pain (LBP) in contemporary dancers.

Participants

Participants were recruited from contemporary dance schools, academies, and professional networks in **Surat** using **purposive sampling**. A total of **40 dancers** were included.

Inclusion Criteria:

- Aged 18-35 years, actively practicing ≥5 hours/week.
- Minimum 2 years of contemporary dance experience.
- Experiencing pain and able to provide informed consent.
- Fluent in English.

Exclusion Criteria:

- Chronic musculoskeletal or neurological conditions.
- Lower limb or spinal injuries/surgeries in the past 6 months.
- Pregnant dancers or those practicing other dance forms without significant contemporary exposure.

Materials

- Examination table/plinth
- Goniometer
- Measuring tape
- Visual Analog Scale (VAS)
- Oswestry Disability Index (ODI)
- Data collection sheets

Data Collection Procedure

After obtaining ethical approval, eligible participants were provided an information sheet and enrolled upon written consent. Standardized flexibility tests were performed **three times**, and the mean was recorded. Pain intensity and disability were assessed using validated tools. All assessments were conducted by the same researcher to maintain consistency.

Outcome Measures

Lower Limb Flexibility

1) **Sit and Reach Test -** Assesses hamstring, hip, and lower back flexibility. Participant sits with legs extended, reaches forward without bouncing. Scores recorded in cm.
   Interpretation: >25 cm: Excellent, 15-25 cm: Good, 5-14 cm: Average, 0-4 cm: Poor, <0 cm: Very Poor.
2) **Quadriceps Flexibility Test -** Measures rectus femoris flexibility using a goniometer. Participant lies prone; knee passively flexed, angle recorded.
   Interpretation: >135°: Excellent, 120-135°: Normal, 90-120°: Mild Tightness, <90°: Severe Tightness.

Low Back Pain Assessment

1) **Visual Analog Scale (VAS) -** 10 cm line from 0 (no pain) to 10 (worst pain) used to measure subjective pain intensity.
   Interpretation: 0: No pain, 1-3: Mild, 4-6: Moderate, 7-10: Severe.
2) **Oswestry Disability Index (ODI)** - Self-reported questionnaire assessing 10 daily activity domains. Total score converted to percentage.
   Interpretation: 0-20%: Minimal, 21-40%: Moderate, 41-60%: Severe, 61-80%: Crippling, 81-100%: Bedridden/ Exaggeration.

All assessments were standardized to ensure **validity, reliability, and reproducibility** of results.

6. Results

Participant Characteristics

Forty contemporary dancers participated (mean age 23.63 ± 5.61 years; height 156.7 ± 9.68 cm; weight 52.63 ± 9.9 kg; BMI 21.41 ± 3.33 kg/m²). Mean dance experience was 4.18 ± 3.1 years.

Flexibility and Clinical Measures

Mean hamstring flexibility was 44.78 ± 7.52 cm, and quadriceps flexibility was 79.84 ± 8.44°. Pain intensity (VAS) averaged 3.95 ± 2.21, and functional disability (ODI) averaged 29.29 ± 20.84%, indicating mild pain and disability in most participants.

Correlation Analysis

Hamstring flexibility showed a moderate positive correlation with VAS ($r = 0.317$, $p = 0.046$), while quadriceps flexibility had no significant correlation with pain or disability. Hamstring and quadriceps flexibility were strongly correlated ($r = 0.868$, $p < 0.001$). ODI showed no significant correlation with flexibility or pain severity.

7. Discussion

The study indicates that **hamstring flexibility is significantly associated with lower back pain severity** in contemporary dancers, whereas quadriceps flexibility is not. This suggests that hamstrings play a key role in lumbar spine stability during dance movements such as bending and leg lifts.

The weak correlation between pain intensity and disability (ODI) implies that dancers can maintain function despite mild to moderate pain, likely due to high pain tolerance and compensatory movement strategies.

The strong correlation between hamstring and quadriceps flexibility highlights the importance of overall lower limb flexibility for biomechanical efficiency. Targeted stretching programs, particularly for hamstrings, may help **reduce LBP severity and prevent injury** in contemporary dancers.

8. Conclusion

This study demonstrates that **hamstring flexibility plays a significant role in reducing low back pain (LBP) severity** in contemporary dancers, while quadriceps flexibility showed no significant association with pain or disability levels. These findings emphasize the importance of **hamstring-focused flexibility training** as a strategy for injury prevention and pain management in this population.

The variability in pain and disability levels suggests that individual factors such as **pain tolerance, technical skill, and training experience** also influence the dancer's experience of LBP.

9. Future Scope

- Examine the role of other lower limb flexibility parameters (e.g., hip flexor, calf flexibility) in relation to LBP.
- Include larger and more diverse samples to validate findings on quadriceps flexibility and disability (ODI).
- Investigate specific patterns of flexibility deficits (hypermobility vs. hypomobility).
- Conduct longitudinal studies to track flexibility and LBP changes over time.

10. Limitations

- VAS and ODI were self-reported, introducing subjectivity.
- Small sample size limits generalizability.
- Objective biomechanical assessments were not included.
- Factors such as age, training history, and dance style were not controlled.

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