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Comparing musculoskeletal pain and postural risk assessment in Bharatnatyam and Kathak dancers

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Abstract
Background: Bharatnatyam and Kathak are Indian classical dance forms that require prolonged duration and high intensity of training. The dancers are prone to musculoskeletal injuries due to repetitive rehearsals. The present study is aimed to compare both Bharatnatyam and Kathak dancers' musculoskeletal pain and postural risk factors by using Numerical Pain Rating (NPRS) and Rapid Entire Body Assessment (REBA) scales. The study hypothesized that either Bharatnatyam or Kathak have more musculoskeletal pain and postural risk due to dance.
Methodology: 212 (106 each group) Bharatnatyam and Kathak dancers were included as per the selection criteria. They were asked to fill out the NPRS and REBA scales. All the data was collected and statistically analyzed.
Results: The mean and standard deviation of the NPRS and REBA scores were 3.2±2.12 and 7.59±1.38 for Bharatnatyam dancers, while for Kathak dancers, they were 3.4±2.32 and 7.58±1.06, respectively. After applying an unpaired t-test for both NPRS and REBA scores the p-values are 0.51 and 0.95 respectively showing that both values are not significant at a 95% confidence interval.
Conclusion: Both dance styles experience musculoskeletal pain and postural risks, yet neither group demonstrates a greater prevalence of these issues than the other.

Keywords: Bharatnatyam, Kathak, musculoskeletal pain, posture, dancers

Introduction
Bharatanatyam is a traditional dance style originating from India. It features precise footwork, elaborate hand signals, expressive facial cues, and energetic body movements. This dance form is celebrated for its elegance and controlled actions [1]. In contrast, Kathak is another classical dance from India, noted for its intricate footwork, the rhythmic drumming of the feet, sharp turns, and sudden pauses [2]. Dancers of Bharatanatyam often convey stories and emotions through their performances, while Kathak is recognized for its "tatkar" (rhythmic sequences) and "chakkars" (captivating spins).
Dancers engage in regular performances, extensive rehearsal hours, skillful movements, artistic expressions, and the upkeep of their postures. They repeatedly execute motions that demand significant flexibility, strength, and stamina, placing strain on their bodies and increasing the risk of overuse injuries that may affect their long-term health [3]. Achieving expertise in this dance form necessitates intense training over extended periods while sustaining specific body positions [4, 5]. In Bharatnatyam, the "Araimandi" stance is the primary position held for the longest time in this dance style.
Injuries frequently occur during dance competitions, performances, and intense rehearsal schedules [6]. Dancers face a heightened risk of injury due to the extended duration and intensity of their training [7-9]. Various dance styles are associated with distinct types of injuries, each displaying unique risk factors [10]. The Kathak dance form, for instance, requires dancers to repeatedly place their ankles in precarious positions, leading to a susceptibility to musculoskeletal injuries in their lower limbs. Additionally, they may present with uncommon foot and forefoot deformities, excessive range of motion in the ankle and great toe, and conditions like pes cavus and pes planus [2].

Research by Paul and Kapoor *et al.* revealed that 29% of dancers were found to have a torn meniscus due to their continual efforts to perfect the Araimandi posture. They also noted that knee injuries tend to be more prevalent in Indian classical dance styles. Despite the limited literature addressing musculoskeletal injuries among dancers, there is a lack of studies comparing pain and postural risk between these two styles. Therefore, this study sought to investigate and compare the musculoskeletal pain and postural risk factors between Bharatnatyam and Kathak dancers.

Materials and Methodology

Approval from the Institutional Ethics Committee (EC/NEW/INST/2019/377/224) was obtained before the study, and informed written consent was obtained. A total of 212 dancers were calculated using Winpepi software, and 106 dancers were divided into each group by a purposive sampling method as per the inclusion criteria: 1. Age group was 18 to 40 years for both dance groups. 2. Dancers who practice 2 hours a day and 3 times a week and have at least 2 years of experience. The criteria for exclusion included dancers who had undergone recent surgery, experienced soft tissue injuries, sustained recent fractures, or exhibited any neurological deficits. After obtaining informed consent, participants were asked to indicate their pain levels using an NPRS (Numerical Pain Rating Scale). The REBA (Rapid Entire Body Assessment) scale for Araimandi & after Tatkar in Utpatti posture was taken in Bharatnatyam & Kathak dancers respectively for evaluating their postural risk. The data gathered was subsequently analyzed using statistical methods.

Outcome measure

1. **Numerical Pain Rating Scale:** This scale evaluates pain using a range from 0 to 10, where 0 indicates 'no pain' and 10 signifies 'worst pain'. The Numerical Pain Rating Scale (NPRS) shows strong test-retest reliability, evidenced by an ICC of 0.82[11].
2. **REBA (Rapid Entire Body Assessment):** This comprehensive assessment tool evaluates the whole body, with Part A focusing on the neck, trunk, and legs, and Part B examining the arms and wrists. The total score is calculated by adding scores from Parts A and B, and including the activity score results in the final REBA score. The interpretation of the scores is as follows: 0-1 indicates negligible risk, 2-3 signifies low risk, 4-7 suggests medium risk, 8-10 represents high risk, and a score of 11 or more indicates very high risk. This scale demonstrates high intra-rater reliability, with an ICC of 0.92 [12].

Statistical Analysis

The comparison of NPRS and REBA score means between groups was conducted using an unpaired t-test. A p-value of less than 0.05 is deemed statistically significant. All findings are presented in both tabular and graphical formats. The complete dataset was statistically analyzed using SPSS version 22.0 for MS Windows.

Results

The research involved 212 dancers, evenly split between 106 Bharatnatyam and 106 Kathak dancers. The average age and BMI (with standard deviation) were 30.38±8.95 years and 24.14±4.05 for Bharatnatyam dancers, and 30.95±10.01 years and 24.35±3.46 for Kathak dancers. This suggests that the initial characteristics of both groups were similar (see Chart 1 and Figure 1).

Groups	Bharatnatyam	Kathak
Age	30.38±8.95	30.95±10.01
BMI	24.14±4.05	24.35±3.46

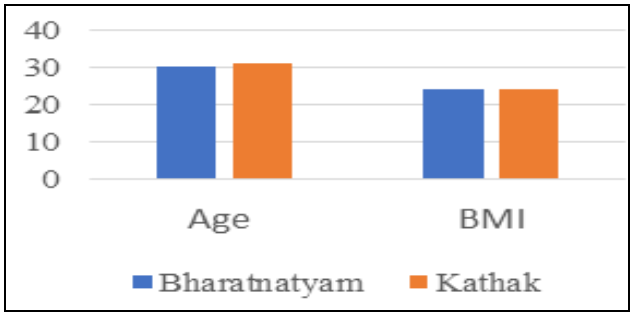

Chart 1 and Fig 1: Mean and standard deviation (SD) of age and BMI of Bharatanatyam and Kathak dancers

The mean and standard deviation (SD) of the NPRS and REBA scores were 3.2±2.12 and 7.59±1.38 for Bharatnatyam dancers, and 3.4±2.32 and 7.58±1.06 for Kathak dancers, respectively. An unpaired t-test was conducted to compare the NPRS scores between the two groups, yielding a p-value of 0.51, indicating no statistically significant difference. Similarly, the comparison of REBA scores using the unpaired t-test produced a p-value of 0.95, indicating no statistically significant difference (Chart 2).

Groups	Bharatnatyam	Kathak	Unpaired t-test
NPRS	3.2±2.12	3.4±2.32	T=0.65, DF=210 p-value=0.51
REBA score	7.59±1.38	7.58±1.06	T=0.059, DF=210 p-value=0.95

Chart 2: Mean and standard deviation (SD) of NPRS and REBA score of Bharatanatyam and Kathak dancers along with p-values

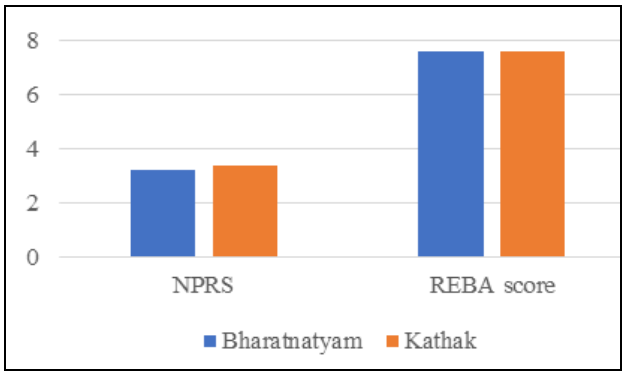

Fig 2: Mean and standard deviation (SD) of NPRS and REBA score of Bharatanatyam and Kathak dancers

Discussion

Bharatnatyam and Kathak are classic Indian dance forms that require longer periods and higher training intensity, and are susceptible to musculoskeletal injuries. This study was conducted to compare the postural risk and pain intensity for both dance forms. According to the selection criteria, a total of 212 (106 each group) Bharatnatyam and Kathak dancers were included in the study. The study includes individuals aged between 18 and 40 years because, up until the age of 40, no deterioration was observed and all human bones mature at a lower age. The study result shows no statistical differences between the NPRS and REBA groups. Therefore, in this

study, we accept the null hypothesis that neither Bharatnatyam nor Kathak dancers have a higher risk of musculoskeletal pain and postural risk due to the dance during their comparison.

The mean NPRS scores for Bharatnatyam and Kathak Dancers were 3.2 and 3.4. There was no statistical difference, but dancers of both groups had mild pain. In Bharatnatyam's Araimandi position, the dancer must be in an upright position, with both knees and feet in opposite directions and the trunk held straight with stomach in. During an effort to reach perfection in a dance posture or step, the compensatory strategy might be used in such a way that the dancer may engage either the correct muscles in a dangerous manner or simply activate undesirable muscle patterns leading to pain [1]. Nevertheless, Balakrishnan Etal claimed that Kathak dancers have pronated foot posture, which may indicate a tendency to foot, knee, and back-related problems, as well as a negative effect on the lower back, consequently leading to pain and dance-related injuries [13].

There was no statistical difference found in both groups on comparing the REBA score. The mean REBA score was 7.59 and 7.58 in Bharatnatyam and Kathak dancers, which reflects that there is a moderate risk of musculoskeletal disorder in both groups. Many studies have stated that the most common site for musculoskeletal injuries in Bharatnatyam dancers is the knee joint [1, 6, 8]. REBA evaluated the Araimandi posture, which requires a combined motion of hip flexion, abduction, and external rotation, knee flexion, and ankle dorsiflexion in a closed kinetic chain position, compressing one's height to at least 3/4th of their original height. In order to increase "turnout" at the hip, there is a compensatory increase in lumbar lordosis, which puts the hip joint in a position where the capsular ligaments are loosened, resulting in anterior pelvic tilt. This increased lumbar lordosis elongates the abdominal muscles, inducing weakening, while the erector spinae and hip flexor muscles shorten and further causing an imbalance in the lumbopelvic complex. Maintaining Araimandi posture and rhythmic stamping of the feet in this posture is most likely to strain the patellar tendon due to force transmission via the patella. Assuming a posture with forced turnout at the knee results in increased activity of the lateral knee stabilizers, leading to biomechanical imbalances at the patellofemoral joint [1]. Whereas kathak features complex and forceful footwork, many spins, and intricate compositions of various body postures [14]. This dance form involves distinct kinematic and kinetic aspects while landing from varying heights [2]. Their feet are constantly exposed to stresses that might lead to instability and postural abnormalities. Compared to other Indian traditional dance styles, Kathak is thought to entail stronger footwork, quick motions, and complicated weight transfers, which put strain on certain muscles and joints. Excessive and repetitive taping can lead to inflammatory diseases such as dancer's tendinitis and medial arch flattening. Kathak dancers are vulnerable to foot conditions and injuries since their feet are constantly exposed to stresses that might create instability and postural abnormalities. As a result, Kathak dancers are more likely to sustain back and lower extremity injuries [15].

Conclusion

Both Bharatnatyam and Kathak dance styles experience mild musculoskeletal pain and moderate postural risk, but neither group demonstrates a greater prevalence of these issues than the other.

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