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## Review

## Correlation Between Foot Posture Index And Foot Angle In Indian Classical Dancers: Review Of Literature

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	<b>Abstract</b>
Published on: 30 May 2025	<p><b>Background:</b> Indian classical dance forms, involve intricate footwork and sustained postures that place significant biomechanical stress on the lower limbs. This repetitive loading can lead to alterations in foot posture and alignment, potentially increasing the risk of musculoskeletal injuries. The Foot Posture Index (FPI) is a clinical tool used to assess static foot posture, while measurements of foot angles, including rearfoot and forefoot angles, provide insights into foot alignment</p> <p><b>Objective:</b> This literature review aimed to evaluate the foot posture index and food angle in Indian classical dancers</p> <p><b>Method:</b> Articles were sourced from reputable databases including PubMed and Google Scholar, spanning 2015 to 2024. The review included systematic reviews, randomized controlled trials, cross-sectional studies, and single-blinded experimental studies examining the impact of foot posture index in Indian classical dancers.</p> <p><b>Result:</b> A total of 20 studies reviewed the correlation between foot posture and performance in dancers. Most studies indicated that proper foot alignment, as measured by the Foot Posture Index (FPI), improved balance, stability, and movement precision in dancers. Several studies found that dancers with more neutral foot postures (lower FPI scores) experienced fewer injuries and better performance outcomes.</p> <p><b>Conclusion:</b> This study concluded that the Foot Posture Index (FPI) among Indian classical dancers shows a significant link between foot posture deviations and the demands of classical dance. The study highlights the need for further research on the long-term effects of these postural changes and advocates for including foot care and alignment training in dance programs to support dancer well-being and performance.</p>
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	<p><b>Keywords:</b> Foot Posture Index, Foot Angle, Indian Classical Dancers, Dance Biomechanics, Foot Alignment, Performance, Injury Prevention.</p>

## INTRODUCTION

Foot health and alignment are fundamental components of physical performance and injury prevention, especially in disciplines that demand precise and repetitive lower-limb activity. Among such groups, Indian classical dancers represent a unique population.<sup>1</sup>

**Bharatanatyam:** Bharatanatyam, one of the oldest classical dance forms, originated in Tamil Nadu and is characterized by its graceful yet powerful footwork, rhythmic hand gestures, and facial expressions. The dance is performed with the dancer positioned in a low stance, often bearing weight on the legs, which can lead to significant pressure on the feet.<sup>2</sup>

In the Araimandi position, the body must be lowered into a challenging half-squat while the heels remain joined and the feet are turned outward. Tatta Adavu, a vital element of Bharatanatyam, involves the execution of foot and ankle movements. The term "Tatta," which means "to tap," describes the leg tapping performed in this Adavu.<sup>3</sup>

**Kathak:** Another renowned dance form, Kathak is recognized for its exceptional footwork. Various statuesque postures and mudras (hand gestures) are used in this form. However, the pounding of the feet may lead to postural deviations in the feet over time.<sup>4</sup>

**Odissi:** In India's dance culture, Odissi dance holds a significant position. This dance form originated in the Hindu temples of Odisha, an eastern coastal state of India.<sup>5</sup>

**Kuchipudi:** Indigenous to Andhra Pradesh, India, Kuchipudi is a classical dance style that was established in the 17th century with the creation of the dance-drama \*Bhama Kalapam\* by Siddhendra Yogi.<sup>6</sup>

Despite the high risk of foot-related injuries among dancers, limited research has been conducted to explore the foot posture of Indian classical dancers specifically. While studies on Western ballet dancers have highlighted the potential link between foot posture abnormalities and injury.<sup>7</sup>

### Foot postural index

The Foot Posture Index (FPI) offers a clinically valid method for assessing static foot alignment. This six-point observational tool evaluates rearfoot and forefoot positions while standing in a relaxed posture, providing a standardized score ranging from pronation to supination. Each component is rated on a scale from -2 to +2, with more negative scores indicating a supinated foot and positive scores indicating a pronated foot. The foot with the higher FPI score is used as the reference leg, and the composite FPI score is used for data analysis.<sup>8</sup>

### Objective of study

This observational study explores foot posture patterns in Indian classical dancers using the Foot Posture Index (FPI). The main goals are to assess the prevalence of various foot postures, examine the relationship between dance practice and foot alignment, identify risk factors for musculoskeletal injuries, and provide baseline data for preventive measures.

## MATERIALS AND METHODS

Literature Online search engines used to collect journals are Google Scholar and PubMed. The authors identified articles based on the keywords. The articles were collected in full text. A total of 19 articles were collected and identified.

### Inclusion criteria

- Articles discussing the foot posture index in Indian classical dancers
- Articles published only in the English language were included
- Articles with full text from 2011 to 2024 have been included
- Articles were included for the age 20- 40 years
- Articles included the female gender

### Exclusion criteria

- Articles published in other languages were excluded
- Articles published before 2011
- Articles exclude neurological conditions
- Articles exclude ankle injuries
- Articles exclude above 41 years

Sno	Author	Title	Duration	Outcome Measures	Study Design	Conclusion
1	Dr.Bhagyashree Salekare <i>et al</i> 2024 <sup>4</sup>	“Association of Foot Deviations with Foot Functional Activity and Dynamic Balance in Female Kathak Dancers”	3months	Dynamic balance by the Navicular drop test, Foot function index, and Y Balance test	Comparative study	Kathak dancers are more prone to have foot deviation such as flat feet. Medial Longitudinal Arch Height has very weak positive correlation with foot function and very weak negative correlation with Y balance test suggesting that flat feet have a very weak impact on foot function and dynamic balance.
2	Dr. Amit S Patel 2024 <sup>9</sup>	Prevalence of foot posture deviations in professional dancers of South Gujarat	6months	Navicular Drop Test and FPI-6,	A cross-sectional study	This study indicates a high prevalence of foot posture deviations according to FPI-6 and moderate prevalence according to the Navicular Drop Test.
3	Shwetha Acharya <i>et al</i> 2024 <sup>5</sup>	Comparison of anthropometric measurements related to the medial longitudinal arch of feet between non-dancers and Bharatnatyam dancers	6 months	Various measurements were taken on both the right and left foot using a wooden platform, foot image, and footprint.	An Observational study	concluded that there were significant changes in the foot arches between the non-dancers and mid-stage and last-stage Bharatnatyam dancers.

4	Dr Shekhar Modak 2023 <sup>10</sup>	Comprehensive Study Of Foot Posture In Bharatnatyam Dance Form	6 months	foot index (fpi)	posture	Experimental study	it was concluded that the Bharatanatyam dancers had increased pronation of foot compared to the control group.
5	Acharya GU 2023 <sup>11</sup>	“Correlation between foot posture index and foot angle in Odissi dancers: An observational study”	6months	Foot index. angle (FFA)	posture forefoot	An observational study	it can be concluded that the FPI is highly correlated with the rear foot and FFA. A positive correlation exists between FPI with the rear foot and FFA.
6	Pavana et al 2023 <sup>12</sup>	“Assessment of Foot Deviations and Associated Foot Injuries and its Effect on Foot Functional Activity among Amateur Adolescent Female Kathak Dancers in Selected Dance Schools in Bengaluru”	6 months and 15 days	Foot Function Index. Visual analog Scale (VAS)			They found the foot posture index was normal and did not limit foot usage during the kathak dance. However, the foot function index indicated severe pain in the subjects, restricting their activities and hindering their dance performance.
7	<u>Mullerpan</u> et al 2022 <sup>13</sup>	Differences in Foot Characteristics Between Bharatanatyam	6 months	navicular drop test and Feiss line. Foot geometry and polarography		Comparative study	Dancers often experience ankle and foot pain due to increased pressure on the foot and over- pronation during walking. These findings will help

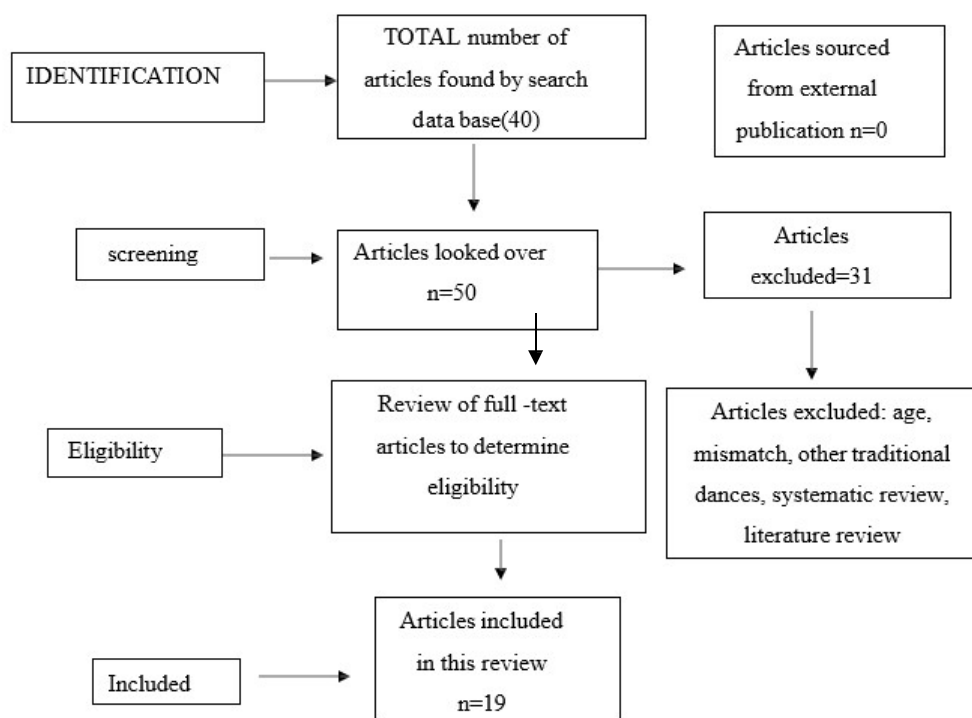
		Dancers and Age-Matched Non-Dancers			healthcare professionals and Bharatanatyam dancers understand foot function and develop strategies to prevent and manage foot pain.
8	Shreya M. Otari*, Anjali Puntambekar (2021) <sup>14</sup>	compare the assessment of the flexibility of the backline and strength of the lower limb in Bharatanatyam dancers and non-dancers		Comparative study	There was no statistical difference in the left lower limb of both groups. There was no statistical difference between the flexibility of backline of Bharatanatyam dancers and non-dancers
9	Vrushali P. Panhale, Prachita P. Walankar 2021 <sup>5</sup>	Postural analysis in female Bharatanatyam dancers: a cross-sectional study	photogrammetric method	a cross-sectional study	Increased lumbar lordosis and anterior pelvic tilt were observed in Bharatanatyam dancers as compared to non-dancers. Hence, it is vital to establish preventive measures like postural re-education, muscular balance, and flexibility to prevent erroneous postural patterns capable of causing pain and injuries.
10	Vrushali P. Panhale et al 2020 15	Analysis of 3 months Postural Risk And Pain Assessment in Bharatanatyam Dancers	rapid entire body assessment tool (REBA).	A cross-sectional study	The findings of this study indicated that the point prevalence of pain in Bharatanatyam dancers is high. <i>Natyarambham's</i> posture is considered high risk based on postural assessment.

11	Sonali Manek et al 2020 <sup>3</sup>	A comparative study of foot posture Deviations in young female kathak and Bharatnatyam dancers.	Foot Posture Index-6 Scale	Comparative Study	There was no significant difference in foot of Kathak and Bharatnatyam Dancers .However Foot of Dancers deviated from that of Non Dancers.
12	Hale Öktem et al (2019) <sup>16</sup>	Evaluate posture and flexibility in ballet dancers	The range of motion of the joints was measured using a goniometer and distances were measured using an anthropometer	Observational study	Postural defects caused by the adaptive changes that occur during ballet training can be assessed easily by using a symmetrical. It is also possible to evaluate the degree of the deformities that can develop over time
13	Shruti Shenoy 2019 <sup>17</sup>	Ground Reaction Forces During Tatta Adavu of Bharatanatyam	6months	Observational study	This study revealed that during the foot tapping in Bharatanatyam about 4-5 times the body weight of ground reaction force is experienced by the dancer. These high impact forces could contribute to the injuries.
14	Rajesh Chavali (MAKuchipudi)2018 <sup>6</sup>	Men in Dance with Special Emphasis on Kuchipudi, a South Indian Classical Dance Tradition		Observational study	Kuchipudi, a south Indian classical dance form originated as a male tradition and later incorporated female traditions and as practiced currently by both men and women went through several changes through course of time

15	Shweta Chandan et al 2018 <sup>18</sup>	Cross-Sectional Study of Foot Posture Index, Navicular Drop, and Arch Index in Kathak Dancers	3months	foot posture index, navicular drop, and arch index.	Cross-sectional	It can be concluded from the present study that there is a deviation in the foot posture of kathak dancers.
16	Monica Sharma, MPT, Shibili Nuhmani, et al (2018) <sup>19</sup>	Comparison of Lower Extremity Muscle Flexibility in Amateur and Trained Bharatanatyam Dancers and Nondancers	6 months	hip flexion, extension, abduction and adduction, external rotation, internal rotation, knee flexion, extension, ankle dorsiflexion (DF), and plantar flexion (PF) by using a standardized goniometer	Comparative study	significant differences in lower limb muscle flexibility between trained and amateur Bharatanatyam dancers and nondancers. These differences may be due to individual dance postures such as araimandi and muzhumandi.
17	Roopika Sabharwal et al in 2017 <sup>20</sup>	Foot Postural Deviations in Female Kathak Dancers		Foot Posture Index, Medial Longitudinal Arch Angle, Navicular Drop,	Observational study	From the observations, it can be concluded that with time kathak dancers start developing certain Postural Deviations at Foot which can lead to hyper pronation

				Rearfoot angle and Forefoot angle.			
18	Dr Shukra Dhaval Chivate, Manali Prasad Kulkarni 2017 <sup>21</sup>	Evaluation of 12 months Foot Posture, Pain, and Ankle Proprioception in Classical and Western Dancers		Foot index 6 and visual analog scale	A Cross-Sectional Study		concludes that there is a significant change in the foot posture of classical dancers. Pain was more observed in classical dancers than in western dancers, and there was no adequate loss of proprioception in the ankle joint in classical and western dancers.
19	K.Vijaya kumar, Dr.S.Sent hil kumar 2016 <sup>22</sup>	Morphometric Analysis of Ankle and Foot in Classical Bharathanatyam Dancers Using Foot Posture Index (FPI) And Plantar Scan Images (PSI)		Clark's angle (CA), Staheli index (SI), Chippaux index (CI), and Arch index (AI)			Sedentary dancers have shown a high level of flatness of the foot arch along with a pronated foot. The ankle and foot problems can be reduced by regular diagnosis and assessment, proper warm-up and stretching techniques and footwear modifications should be made to prevent deformities

### Consort chart



### Discussions

The Foot Posture Index (FPI) is a widely used tool for assessing foot alignment in various populations, providing valuable insights into potential biomechanical issues. In this observational study of Indian classical dancers, the FPI was employed to evaluate foot posture and identify deviations from normal alignment that could affect dance performance or contribute to musculoskeletal problems.

Indian classical dancers are known for their intricate and repetitive movements, which require great balance, flexibility, and strength. These dance forms feature unique postures, stances, and weight distributions that can significantly impact foot alignment. It was found that certain deviations in foot posture, such as pronation or supination, are more commonly observed among dancers. This trend may be linked to the specific physical



demands associated with classical dance styles.

It is essential to recognize that considerable stress is placed on the feet by Indian classical dance forms, such as Bharatanatyam, Kathak, Odissi, and Kuchipudi. Therefore, close attention must be paid by dancers to their posture and alignment during performances. Changes in foot structure can occur over time due to the prolonged and intense use of the feet, some of which may lead to abnormal postures. Notably, excessive pronation, which is commonly observed in these dancers, raises the risk of developing conditions such as plantar fasciitis, Achilles tendonitis, and stress fractures. The need for foot care and injury prevention strategies tailored specifically for classical dancers is underscored by these findings.

It is suggested that dancers who maintain neutral or well-aligned foot postures may experience a lower risk for overuse injuries and musculoskeletal issues. Incorporating foot strengthening and alignment exercises into the regular training routine for Indian classical dancers could be beneficial. However, since the study's sample is limited to a specific population, further research that includes a broader range of dancers—both experienced and novice could provide a more comprehensive understanding of how foot posture affects long-term health and performance.

## CONCLUSION

In conclusion, a significant correlation between foot posture deviations and the physical demands of classical dance is revealed by this observational study on the Foot Posture Index (FPI) among Indian classical dancers. It is noted that certain foot postures, particularly pronation and supination, are common among dancers and may be associated with an increased risk of foot and ankle injuries. Regular monitoring of foot posture and the implementation of preventive care measures, such as targeted strengthening exercises and footwear modifications, are recommended to help reduce injury risk and enhance overall performance. The importance of recognizing the impact of dance-specific movements on foot health is emphasized. Additionally, the need for further research to investigate the long-term effects of these postural changes is highlighted. A holistic approach that includes proper foot care and alignment training should be integrated into dance training programs to ensure the well-being of dancers and improve their performance capabilities.

## Limitations

Several limitations were encountered during this study. The sample size was relatively small, which may affect the generalizability of the findings. Additionally, the study was conducted in a specific cultural context, which may not be representative of all Indian classical dancers. The observational nature of the study limits causal inferences, and the reliance on self-reported data regarding dance practices and experiences may introduce bias.

## Recommendations

To address these limitations, it is recommended that future research involve larger and more diverse samples to improve the generalizability of the findings. Longitudinal studies should be conducted to explore the causal relationships between foot posture deviations and injury risk among dancers. Standardized assessment tools for foot posture should be utilized to ensure consistency in data collection. Furthermore, dance training programs should incorporate routine foot health assessments and tailored preventive measures to enhance dancer safety and performance.

## Abbreviations

Foot posture index (FPI); forefoot angle (FFA); Clark's angle (CA); Staheli index (SI); Arch index (AI); Visual analogue scale (Vas); Chippaux index (CI).

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