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Prevalence Of Flat Foot In Dominant Lower Limb Among Professional Kathak Dancers

Chaitrali Omkar Shukla[1], Dr. Aakanksha Bhat[*2]

[1]B. P. Th, D. Y. Patil College of Physiotherapy, D. Y. Patil Education Society (Deemed to be university, Kolhapur
Email ID: chaitralishukla75@gmail.com

[*2]Assistant professor, Neuroscience physiotherapy, D.Y. Patil College of physiotherapy, D.Y. Patil Education Society (Deemed to be university), Kolhapur

[*]**Corresponding author:**
Dr. Aakanksha Bhat
Email ID: physioakanksha25@gmail.com

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ABSTRACT

Background: Kathak, a classical Indian dance form which includes repeatedly rhythmical footwork spinning movements often perform barefoot on hard surface. Prolonged and intense training may lead to biomechanical changes in the foot, including flat foot. Not only kathak but the all classical dance forms have their own character of presentation which may lead to the postural changes.

Methods: A cross-sectional study was conducted among professional Kathak dancers in Sangli, Miraj and Kolhapur city. Total 107 samples are included according to inclusion criteria which consist of age between 16-42 years, female gender and has experience of more than 5 years; and individual who had previous surgery of foot, recent trauma to foot/ankle and congenital flatfoot are excluded . The study focuses on dominant lower limb, so to find dominant lower limb kick test is used. The deviation foot is determined by Foot Posture Index (FPI) and Clark's angle.

Results: Result shows 84 positive and negative 23 in individuals out of 107 individuals which results in significant prevalence of flat foot in dominant lower limb among Kathak dancers. Percentage of positive and negative results are 78.50% and 21.50% respectively so, the prevalence of the study is 78.50%. mean values of age, year of experience, practicing hours per day FPT and Clark's angle was calculated and noted in tables.

Conclusion: The study concludes that high frequency Kathak practice may contribute in postural deviation and development of flatfoot. Preventive strategies such as foot strengthening exercises, Modified training surfaces, and orthotic support may help reduce the risk. Further research is needed to explore long term biomechanical impacts and gender specific differences.

Keywords: *Flat foot, Lower limb, kathak, dancer, professional.*

1. INTRODUCTION

Indian classical dance includes body, mind, and emotion called abhinaya; although there are different dance forms present but these dancers suffers from common or similar musculoskeletal injuries. [1]

Each of these classical dance forms has their own specialty like Bharatnatyam composed by stiff movements, eye movements and has their typical posture of knee and hip flexion and hip internal rotation where Kathak includes soft movements, vigorous footwork, spinning movements; Kucchipudi involves fast-paced, intricate rhythmic patterns, precise foot placements; Odissi has two techniques chowk and Tribhanga means masculine ,square like posture in which body weight is evenly distributed and feminine posture in which body deflects at the neck ,torso, and knees; Kathakali has more weight on facial expressions, costume; Mohiniattam includes soft footwork and it is called as Dance of Enchantress and lastly Manipuri contain spiraling movements Lahsya and Tandav which shows feminine and masculine character respectively.[2] All the classical dance have common features such as Mudras (gestures made with hand), posture or positions, and expressions or Abhinaya because these all dance forms share their roots.[2]

It is found that in all forms of dance injuries happen due to continues tapping of foot in kathak and spinning techniques. Bharatnatyam use typical posture of knee hip flexion they have to maintain the same posture for much time so because of sheer quantity of force passing through the lower extremities might contribute to injuries also Kuchipudi includes body

balance grace and fluid movements of this dance form make it unique and breath taking, Kathakali dance requires much strength and it is typically performed by male dancers they shift their weight from one foot to another with leg extension; mohiniattam dance includes swaying on boards hip and light movements so they need more balance and to maintain erect posture likewise each dance has special character which might lead to changes in musculoskeletal structure.[2,3]

Kathak is a classical dance originated from Uttar Pradesh and North India.[4,5] It includes storytelling or conveying a story in the form of entertainment. It includes all classical elements such as nritta, nritya, and natya. Kathak is known for its intricate footwork which is called as "Tatkar" and is the main component of it also kathak contain Spin known as Chakkars, and use of bhav in abhinaya.[5,6]

Tatkar is a component in which foot is tapped on the ground for several times in minute. It entails variety of pattern, rhythms, and variations with precise, speed, and clarity. In this speed ranging from slow to fast graceful movements which contains energetic sequences. Dancers also shows swirls or chakars (spinning movements) at warp speed with series of mudra. Mudra is a typical position of single or bilateral hands.[2] Tatkar and chakkars needs coordination, strength, and control from lower limb muscles. Repetitive movements of footwork stimulates hamstrings , quadriceps, calves, and for tapping on foot requires flexor hallucis and flexor digitorum longus. Ankle and foot depends on tibialis anterior, gastrocnemius, and peroneal muscles where for tatkar and chakkars the gluteal muscles stabilizes hip. During dynamic footwork joint support is provided by plantar fascia, the calcaneofibular ligament, and the anterior and posterior tibiofibular ligament.[2]

Kathak dancers use ghungroos (ankle bells) of around 100 to 150 bells on each ankle which has weight of 1 to 1.5 kg, using these dance bells while doing footwork or any other performance adds additional stress. With time use of these ankle bells daily may overload the connective tissue of leg and lead to over extension. It is hard to lift the leg while dancing, leg muscles have to work harder due to weights. [7] The normal stance positions of foot in kathak is V shaped i.e. heel touch together and forefoot apart which caused additional strain on inner side of the foot. [8]

It is found that foot of kathak dancers is being exposed to various stresses in their daily routine due to which foot adopts itself to compensate these forces by certain alterations in biomechanics.[5] Likewise, repetitive pounding of the foot with ghungroos over the floor may lead to depress medial longitudinal arch permanently as medial longitudinal arch is extremely resilient.[5] Flexor hallucious longus and flexor digitorum longus are the muscles used while tapping of foot on floor and these muscles only help for formation of medial longitudinal arch while providing support to it. Repetitive overuse of these may give further rise to inflammatory condition such as dancer's tendinitis with reduction on medial arch.[2]

Past studies have examined the prevalence of flatfoot among dancers, athletes, and individuals who have routine of high-impact activities. Research has found that classical dancers exhibit higher incidences of pes planus compared to non-dancers. The lack of arch support and excessive repetitive force exerted on the feet make them vulnerable to structural changes.[2] So basically, increased tension and load due to posture, tapping of foot lead to the biomechanical changes in the joints and pain.[9] There are 23% to 45% of foot and ankle injuries in professional musical theatre dancers are noted or has been reported in past studies and about 34% to 62% represents foot and ankle injuries are reported of all reported injuries reported as the ankle and foot of dancer's foot and ankle are particularly vulnerable.[4]

Biomechanics of the foot plays crucial role for balance, stability, and performance in kathak. For dynamic movements properly aligned of foot is required which provides the foundation. So due to tapping and prolonged barefoot practice and forceful foot strikes may contribute to changes in foot structure. [10] Biomechanics is important to prevent abnormal weight bearing loads. Dancers frequently have both primary and secondary kinetic chain dysfunctions. Deformities of the rear foot and forefoot, excessive range of motion in the ankle and great toe, pes cavus, and planus all lead to foot and ankle ailments that extend up the kinetic chain. The majority of these malfunctions occur when the dancer is landing from a leap or spinning. They must land on one foot for a lot of dancing jumps. This frequently puts the dancer at a disadvantage and increases the risk of injury. [11,12]
Flatfoot can develop due to genetic predisposition, excessive mechanical stress weak arch-supporting muscle, and improper training techniques.[13] Kathak use prolong standing, wear ghungroos, repeated stomping, and extended training sessions; after time these factors can weaken intrinsic muscles of foot which further leads to collapse of arch.[14] Flat foot affects foot alignment, stability, and weight distribution, potentially impairing a dancer's ability to perform high-intensity movements. It may lead to fatigue, discomfort, and increased injury susceptibility. Some dancers compensate by altering their posture, which can further contribute to musculoskeletal issues in the knees, hips, and spine.[15] Loss of concavity of foot of the sole leads to compression of the nerves and vessels of the sole. which cause metatarsalgia, compressed blood vessels lead to vascular disturbances in the sole of foot, also Loss of springs in foot leads to a clumsy and shuffling gait, loss of shock absorbing function makes the foot more liable to trauma and osteoarthritis also it causes vascular disturbances.

Dominant limb is most used to put more pressure and effectively so maybe there are chances to get dominant limb affected in kathak So, to find out this take precaution and create awareness about the condition among dancers, this study will be conducted.

2. MATERIALS AND METHODOLOGY

The study protocol was presented for approval in front of institutional ethical committee and protocol committee of D. Y. Patil Education Society, deemed to be university Kolhapur and D.Y. Patil College of Physiotherapy, Kolhapur and Ethical approval was granted by the committee.107 participants from Kathak Nritya Kendra at Miraj, Kolhapur and Sangli were selected based on the inclusion and exclusion criteria.

Inclusion criteria Female participants belonging to the 16-43 years of age group, and practising Kathak for more than 5 years.

Exclusion criteria Participants having recent injuries to ankle and foot, Congenital deformity of foot and having Any surgical history of foot.

Participants from Kathak Nritya Kendra at Miraj, Kolhapur and Sangli were selected for the above study. Potential subjects were approached and provided with an explanation of the study's purpose. Written consent was obtained from the participants. Participants for the study were recruited and they underwent assessment of Flatfoot using Foot Posture Index (FPI), Clarks angle and dominant limb by using Kick test. Demographic data including name, age, and gender were collected using a standardized data collection sheet. Participant assessed with Kick test to find out the dominant lower limb. It contains various task which will be done by participant.

3. KICK TEST

To check the leg dominance certain healthy adults were given a questionnaire and asked to perform six different task to rule out the leg dominance. Some tasks were considered reliable to determine the dominance of the leg such as kicking a ball at a target placed four meters away, picking up five marbles which are arranged in a vertical line and putting them in a box by using one foot while standing, stomping out an imaginary fire displayed on a sheet of paper using one foot while standing, tracing the shape of a house using one foot while standing.

These four tasks were made to perform by the individuals and are considered reliable. The dominant leg in this bilateral mobilizing task is also the dominant leg in a unilateral stabilizing task in about 50% of men and 70% of women. Footprint was taken on plain white board to calculate clerk's angle to detect reduced medial longitudinal arch of foot. Pronation of foot will be assessed by using FPI (Foot Posture Index), on a FPI data sheet score will be noted and calculated.

The statistical analysis utilized appropriate bio-statistical tools and was conducted using the master chart data. This analysis aimed to calculate the prevalence of Flatfoot in dominant lower limb among professional Kathak dancers.

4. RESULT

Table 1 : Prevalence of the Flatfoot

RESULT	FREQUENCY (N)	PERCENTAGE (%)
POSITIVE	84	78.50%
NEGATIVE	23	21.50%
TOTAL	107	100.00%

Table No. 1 shows tabular format of no. of participants who have been positive for prevalence of flat foot in dominant lower limb among professional kathak dancers. Which concluded that there were 84 participants positive which constitute 78.50% whereas 23 participants were negative constituting 21.50%.

Table 2: mean value of age and year of experience

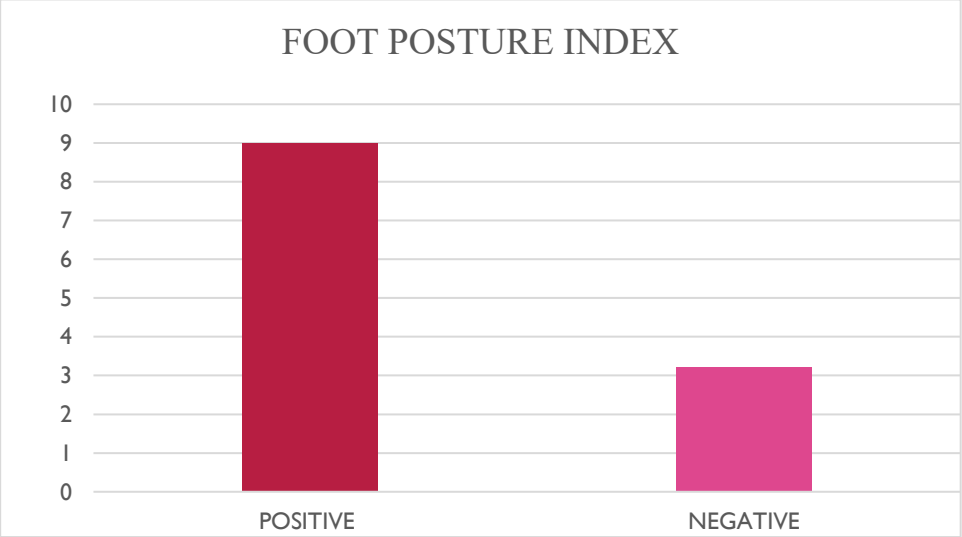
	AGE	YEAR OF EXPERIENCE
POSITIVE	24.44	13.77
NEGATIVE	17.56	8.13

Table No. 2 shows tabular format of mean value of age and year of experience. The mean value of age in positive criteria is 24.44 and in negative 17.56 also average value of year of experience in positive criteria is 13.77 and in negative 8.13.

Table 3: Mean value of practicing hours per day

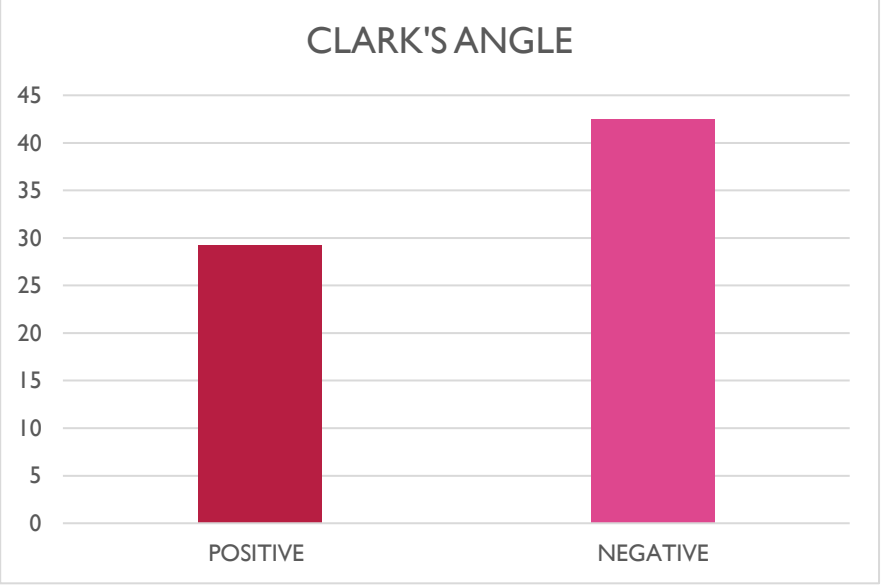
	HOURS/DAY
POSITIVE	2.71
NEGATIVE	2.65

Table No. 3 shows tabular format presentation of mean value of practicing hours per day. Mean value for practicing hour per day in positive is 2.71 and negative is 2.65 respectively.



Graph 4: mean value of Foot Posture Index

Graph 4. shows graphical presentation of mean value of Foot Posture Index. Mean value of Foot Posture Index in positive is 9 and negative is 3.21 respectively.



Graph 5. graphical presentation of mean value of Clark's angle

Graph 5. shows tabular format and graphical presentation of mean value of Clark's angle. Mean value for practicing hour per day in positive is 29.28 and negative is 42.51 respectively.

5. DISCUSSION

In the above study, 78.50 % of individuals has flatfoot including mild and moderate according to FPI and Clark's angle; negative 21.50 %. Among 107 sample 23 shows negative results and 84 shows positive.

The mean value of age in positive criteria is 24.44 and in negative 17.56 In previous study by Shweta Chandan, Savita Tamaria, Davinder Gaur, Charu Chadha, Priyanka Sharma [4] named A Cross-Sectional Study of Foot Posture Index, Navicular Drop and Arch Index in Kathak Dancers showed mean value of 22 in age which is near to mean of age in this study i.e. 24 also the inclusion criteria for the that study is more than 5 years which shows positive results. In my study Average value of year of experience in positive criteria is 13.77 and in negative 8.13

Mean value for practicing hour per day in positive is 2.71 and negative is 2.65 respectively. These values are quite similar to each other which does not exactly shows the correlation. Future can increase or decrease the hours to find the exact result.

Mean value of Foot Posture Index in positive is 9 and negative is 3.21 respectively interpretation of Foot Posture Index (FPI) is 0 to 5 considered normal foot, 6 to 9 shows pronated foot and ≥10 shows highly pronated foot. The mean value in this study shows pronated foot in most of the positive individuals and few are in highly pronated according to the data collected.

Mean value for practicing hour per day in positive is 29.28 and negative is 42.51 respectively. The interpretation of Clark's angle are- the study shows more degrees of angle in negative individuals and reduced in positive individuals.

The study reveals a significant high prevalence (78.50) of flat foot in dominant lower limb in kathak dancers. This suggest that prolonged and intensive training might contribute to the development of flatfoot.

Impact of training duration dancers with more than 3-4 hours practice per day with more than 8 years of experience or practice according to result and mean value this may be indicate possible correlation between training intensity, time and foot structure changes.

The negative group had a lower frequency of training suggest that reduce practice might lower the risk of foot structure changes. This might raise a question about role of rest and recovery in foot health.

The study focuses on female gender, emphasizing the need for further research to explore gender differences in foot biomechanics among professional dancers.

The repetitive tapping movements in Kathak could lead to altered arch mechanics, potentially weakening the foot's natural arch support over time, future study may focus on preventive strategies, treatment and foot modifications for the same.

The dominance of one lower limb for leading footwork may contribute to asymmetrical stress, increasing the risk of flat foot. Barefoot dancing on hard surfaces, common in kathak practice may exacerbate foot structure changes due to lack of cushioning and arch support.

Also, previous studies said that Tatkar and chakkars needs coordination, strength, and control from lower limb muscles. Repetitive movements of footwork stimulates hamstrings , quadriceps, calves, and for tapping on foot requires flexor hallucis and flexor digitorum longus. Ankle and foot depends on tibialis anterior, gastrocnemius, and peroneal muscles where for tatkar and chakkars the gluteal muscles stabilizes hip. During dynamic footwork joint support is provided by plantar fascia, the calcaneofibular ligament, and the anterior and posterior tibiofibular ligament.

6. CONCLUSION

The study highlights a high prevalence (78.50%) of flat foot which includes both mild and moderate in dominant lower limb among professional kathak dancers, particularly those with over 8 years of experience and 3-4 hours practice per day. The repetitive high-impact, barefoot training on hard surface, and prolonged practice duration appear to contribute significantly to arch collapse.

Given these findings, implementation preventive strategies such as foot strengthening exercises, orthotic support, and modified training surfaces may help mitigate the risk of flatfoot. Future research should explore gender differences, long term biomechanical impacts, and effective interventions to support the foot health of Kathak dancers.

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