



COMPREHENSIVE STUDY OF FOOT POSTURE IN BHARATNATYAM DANCE FORM

Dr Shekhar Modak¹ Dr Rakhi Sivakumar² Dr Jinesh Rathod³

Director (SAIMS), Senior Physiotherapist, Physiotherapist

BSTRACT

Background: It has been found that extreme physical demands imposed by dancing techniques causes musculoskeletal injuries in dancers. A major causative factor for the changed kinematics of the lower limbs is the altered posture of the feet. Any deviation from the neutral calcaneal position may cause compressive loading of joints due to incorrect direction of weight bearing forces, there is a need to assess the foot posture of Bharatanatyam dancers in order to understand the effect of repetitive tapping of feet during the dance.

Objective: The objective of this study of the study was to determine and compare the foot posture between the Bharatanatyam dancers and age matched non dancers using the Foot Posture Index.

Method: Research was carried out Convenience samples of 30 Bharatanatyam dancers were taken between ages 18 years and above and 30 age matched control group was also taken. An informed consent was taken before the procedure. Subjects who met the inclusion and exclusion criteria were taken into study group and control group respectively. Following baseline information foot posture index was measured of both the groups, Mann-Whitney U test was used to compare the foot posture between the study and control group and t- test was used to compare the foot posture index score with in the Bharatanatyam dancers left foot and right foot. Confidence interval was computed as 95% for the present study

Results: Results showed that Bharatanatyam dancers have more pronated foot posture as compared to the control group. The six individual components also showed significant difference indicating increased pronation.

Conclusion In view of the results of the study, it was concluded that the Bharatanatyam dancers have increased pronation of foot compared to control group.

Keywords: Foot posture, Bharatnatyam, Foot pronation

INTRODUCTION

The lower leg, ankle and foot form the terminal portion of lower extremity kinetic chain. The foot and ankle provides a base of support that aids in postural stability and flexibility^{1,2}. The lower extremity chain bears responsibility for important daily functions, the most essential being weight bearing and ambulation. Some of the activities that require lower extremities to react to these forces are running, jumping, landing and dancing.³

Because the relationship between the leg and the foot establishes lower extremity stability, the ankle is a crucial joint to understand in the context of dance. Its role is to synchronize with the leg and foot, making it vital to the dancer's ability to execute. In addition, one of the most usually damaged body parts in dancing is the ankle.

Dancers are a unique combination of artist and athlete, putting them at risk for musculoskeletal injuries and discomfort.. For starters, most dancers begin their training at a young age, which may have a significant influence on their future health.. The health literature has paid little attention to dancers as an occupational category.⁴

Bharatanatyam is the most popular form of Indian classical dance in South India, and the most ancient of all the classical Indian dance styles in They are all based on India's classical dance bible, the natya shastra ⁵

It is a dynamic and energetic dance form. It is also precise and balanced It consists of stamping the feet in a rhythmic pattern, Jumping, pirouettes, this can occur in situations when the knees are in touch with the floor.

There are 3 basic types of foot positions-

- 1) The entire foot is in contact with the ground, and the weight is evenly distributed. "Tattu" is the stamping of this flat foot on the earth.
- 2) Only toes touch the ground.
- 3) When toes are raised and heel touches the ground.

All these foot movements are done in "araimandali" position Closed chain knee flexion is combined with hip abduction and external rotation in this position. When a dancer's height is compressed to at least 3/4th of their original height, they are said to be in a half-sitting position. This tends to give the dancer a typical triangular shape and in turn stability to the dance forms. Ideally in this posture, the dancer's back should not jut out, the stomach should not protrude out and the torso should not bend forward The "Brahmasutra" (the vertical imaginary line flowing through the centre of the body) should be balanced in the posture..⁶

There are 10 important Adavus. The most important is the 'tatta' adavu, which means to tap. In this, the dancer sits in the araimandali position and taps the feet rhythmically throughout the dance.⁶

V. Anbarasi et al. conducted research to discover lower extremity muscular flexibility metrics in Bharatanatyam dancers Flexibility (hamstring tightness, hip internal and external rotation, and tendoachilles tendon) was assessed in supine and seated postures.. Injured dancers showed high hamstring tightness that lead to pain and musculoskeletal disorders. Tendoachilles flexibility was low in both positions i.e. supine lying and sitting for injured dancers.⁵

Pointe is the full plantar flexion of the ankle and foot with weight bearing on the toes. A midfoot sprain is the most likely injury at this position.⁸

Demi Pointe is similar to Pointe but includes 90 degrees of metatarsophalangeal joint hyperextension with foot equinus.⁹

Pile, which comprises of bilateral deep knee flexion, requires the heels to rise. And Knees attain maximum knee flexion before heel rise in demi-plié. Repetitive movement of these positions can lead to patellofemoral pain syndrome and increased stress on the anterior structure.⁹

Injuries seen in ankle and foot can be listed as ankle sprain, cavus feet, dancers tendinitis, stress fractures, plantar fasciitis, achilles tendinopathy, tibialis posterior and flexor hallucis longus tendon injury, metatarsalgia, ankle impingement, mid foot sprain, lateral ligament injury, medial ankle injury, subtalar subluxation, cuboid subluxation, metatarsal stress fracture, and hallux rigidus.^{5,8,9}

In knee, injuries like iliotibial band syndrome, patellar dislocation, etc. may occur. In hip, injuries like hamstring injuries, labral tears, etc. are seen. Injuries like spondylosis, stress to pars interarticularis, and trauma to intervertebral disc are common in spine.^{5,7,9}

Bharatanatyam positions are more complex than ballet.⁵

In order to prevent abnormal weight-bearing loads, proper biomechanics of ankle is crucial in a dance. Both primary and secondary kinetic-chain dysfunctions are common among dancers. Foot and ankle problems can be caused by abnormalities in the back and forefoot, an excessive range of motion in the ankle and great toe, pes cavus, and planus. When the dancer spins or lands after a leap, the majority of these dysfunctions are visible.¹⁰ Abduction, plantar flexion, and eversion all contribute to excessive foot pronation.

Pronation causes the medial longitudinal arch to flatten, which might lead to compensating forefoot varus. During the gait cycle, the subtalar and mid tarsal joints travel beyond their normal range of motion and the foot remains pronated for an extended length of time. This is the condition many lower limb overuse injuries are thought to be caused by this syndrome. Medial tibial stress syndrome, plantar fasciitis, hallux rigidus, and patellofemoral pain syndrome have all been associated to having a pronated foot type. Furthermore, subtalar pronation and internal tibial rotation have been shown to pre-load the ACL, preventing it from restricting anterior tibial translation and resulting in ACL injury.¹²

Increased supination might also result in foot injuries. Supination is a combination of dorsiflexion, inversion, internal and external rotation at the back of the foot. Supination of the foot is linked to stiffness and poor shock absorption because it locks the subtalar joint to keep the body balanced and conserve energy, and create a hard lever to push off during the gait's last stride¹⁴. According to Imam et al., Individuals with a rigid supinated foot have a more laterally deviated subtalar axis and a calcaneal varus, making them more susceptible to lateral ankle sprains¹⁵. It also puts strain on the ankle's lateral ligament.

However, both excessive foot pronation and supination can lead to injuries in foot and higher up in the knee. People who tend to be flat-footed and have a high midfoot plantar pressure ratio demonstrated an increase in centre of pressure sway. Therefore, foot arch structure contributes to postural control also.

There are many studies on musculoskeletal injuries performed on dancers of different dance forms like ballet, hip-hop, jazz, etc. Bharatanatyam is the oldest classical dance form in India. Till date there is only one published article from Chennai on analysis of lower extremity muscle flexibility among Indian classical Bharatanatyam dancers.⁵

It has been found that extreme physical demands imposed by dancing techniques causes musculoskeletal injuries in dancers. Majority of dance injuries are found to be chronic in nature and mainly seen affecting the low back and lower extremity. Although it has been shown that any variation in foot posture from neutral may predispose to lower extremity injuries, literature establishing this correlation is scanty. Therefore, there is a need to assess the foot

posture of Bharatanatyam dancers in order to understand the effect of repetitive tapping of feet during the dance, in the araimandali position and to reduce their risk of sustaining lower extremity injuries.

METHODOLOGY

AIM

To determine the foot posture in Bharatanatyam dancers using Foot Posture Index.

OBJECTIVES

- 1 To determine the Foot Posture Index scores in Bharatanatyam dancers.
- 2 To determine the foot posture in age matched control group using Foot Posture Index.
3. To compare the Foot Posture Index scores between Bharatanatyam dancers and control group.

HYPOTHESIS

NULL HYPOTHESIS

There will be no significant difference between the Foot Posture Index scores in Bharatanatyam dancers and control group.

ALTERNATE HYPOTHESIS

There will be a significant difference between the Foot Posture Index scores in Bharatanatyam dancers and control group.

INCLUSION CRITERIA FOR STUDY GROUP:

1. Both males and females.
2. Age: 18-above
3. 2 or more than 2 years of Bharatanatyam dancing.
4. Bharatanatyam dancers practicing at any of the 3 levels of the dance -junior, senior or master.
5. 8 hours of practice per week.

EXCLUSION CRITERIA FOR STUDY GROUP:

1. Previous fractures of lower limb hindering dancing.
2. Dancers who have undergone any surgery.
3. Dancers with neurological deficit.
4. Deformities of the lower limb.
5. People involved in professional sport.
6. Dancer recently infected from covid-19/ novel coronavirus.

INCLUSION CRITERIA FOR CONTROL GROUP:

1. Both males and females.
2. Age-18 years and above
3. No professional or recreational sport or dance activity.

EXCLUSION CRITERIA FOR CONROL GROUP:

1. History of recent injury and lower extremity surgeries.
2. Deformities of lower limb.

SAMPLING TECHNIQUE:

Simple random sampling

1 SAMPLING SIZE: 60 subjects

2 STUDY DESIGN: cross-sectional study

STUDY DURATION: 1-time assessment

1 Sampling for 6 months

STUDY SET UP

1. Department of Physiotherapy. SAIMS Hospital Indore.
- 2 Natraj Dance Academy, Indore.

OUTCOME MEASURE:

FOOT POSUTRE INDEX (FPI)

TOOLS USED

- 1 Foot posture index
- 2 Protractor
- 3 Water soluble marker pen
- 4 Inch tape
- 5 Weighing scale

PROCEDURE:

Bharatanatyam dancers who met the study's inclusion and exclusion criteria were used as participants. The study's goal and procedures were explained to all of the subjects. A formal informed consent form was signed by each participant. All of the participants' demographic data, including their name, age, sex, height, weight, number of years of dancing, and weekly dancing

time was obtained prior to the commencement of the study. After that, the foot posture was assessed using the Foot posture index.

The participants were asked to stand on an elevated firm platform in relaxed static double leg stance. Relaxed double leg stance was used as it is said to approximate the position about which the foot functions during the gait cycle. The participants were asked to march for some time on the spot before taking the measurement and then to relax and stand still with the arms by their side and looking straight ahead. Each limb was scored independently in relaxed double leg stance. The following components were observed:

1. Talar head palpation
2. Curves above and below lateral malleoli
3. Inversion and eversion of calcaneus in frontal plane
4. Bulge in the region of talo-navicular joint
5. Congruence of medial longitudinal arch
6. Adduction and abduction of fore-foot on rear foot.

Each item was evaluated on a scale of -2, -1, 0, +1, +2, with a negative score indicating more supinated foot posture and a positive score indicating more pronated foot posture, while neutral posture was given a score of 0. The total score ranged from -12 to +12, with -12 being the lowest and +12 being the highest. With the exception of talar head palpation, all components were graded by observation.

Similarly, the subjects in the control group were chosen, matched by age, and their foot posture was evaluated.



The above figure shows the markings of the talar head in both the feet.

CURVES ABOVE AND BELOW THE LATERAL MALEOLUS



The marks of the curve above and below the lateral malleolus are shown in the diagram above.

INVERSION AND EVERSION OF THE CALCANEUS IN THE

FRONTAL PLANE



The above figure shows measurements of the deviation in the angle of the calcaneum in the frontal plane using a protractor.

BULGE IN THE AREA OF THE TALONAVICULAR JOINT



A bulge may be seen in the region of the talonavicular joint in the illustration above.

CONGRUENCE OF THE MEDIAL LONGITUDINAL ARCH



The congruence of the medial longitudinal arch is depicted in the diagram above.

STATISTICAL ANALYSIS AND RESULTS:

The data was analyzed using the Mann-Whitney U test. The p0.05 significance level was used. SPSS 20.0 statistical software was used to analysis the data, while Microsoft Excel was used to construct tables. A total of 60 people were recruited to compare the foot posture of Bharatanatyam dancers with a control group.

The study group consisted of 30 Bharatanatyam dancers in all. This group consisted of 27 females and 3 males. The control group included 26 girls and 4 males of similar ages.

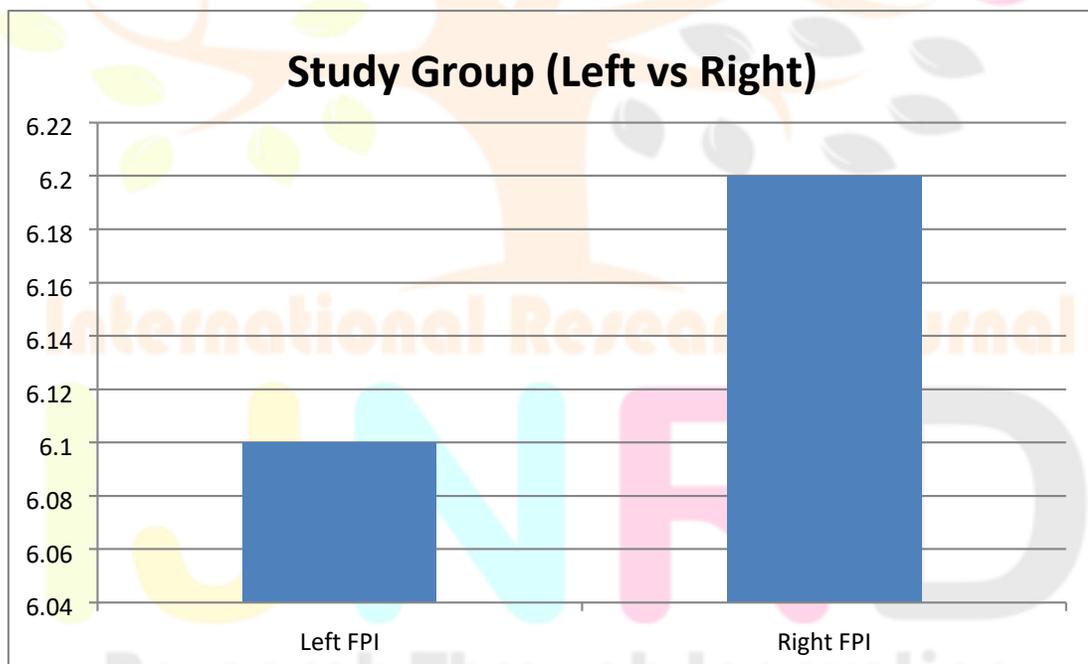
TABLE: 1: DEMOGRAPHIC DATA AGE

Group	N	Mean	Std. Dev.
Study Group	30	21.1	3.511
Control Group	30	21.1	3.511

TABLE: 1: The above table shows that both the groups were homogenous in nature in respect to age.

TABLE: 2: COMPARISON OF TOTAL FOOT POSTURE INDEX SCORE BETWEEN (LEFT FPI VS RIGHT FPI) STUDY GROUP

STUDY GROUP	N	MEAN
TOTAL LEFT FPI SCORE	30	6.1
TOTAL RIGHT FPI SCORE	30	6.2



GRAPH: 1: THE ABOVE GRAPH SHOWS THE MEAN OF LEFT AND RIGHT FOOT POSTURE INDEX TOTAL SCORE IN STUDY GROUP

The mean value of the FPI score of left foot is 6.1 and right foot is 6.2, this demonstrates that there is no discernible difference between the left and right foot.

TABLE: 2: DEMOGRAPHIC DATA HEIGHT, WEIGHT AND**BODY MASS INDEX**

	GROUP	MEAN	STANDAR D DEVIATIO N
Weight	Study group	58.03	9.118
	Control group	54.80	9.193
Height	Study group	163.67	6.930
	Control group	160.53	7.128
BMI	Study group	21.686	3.354
	Control group	21.287	3.503

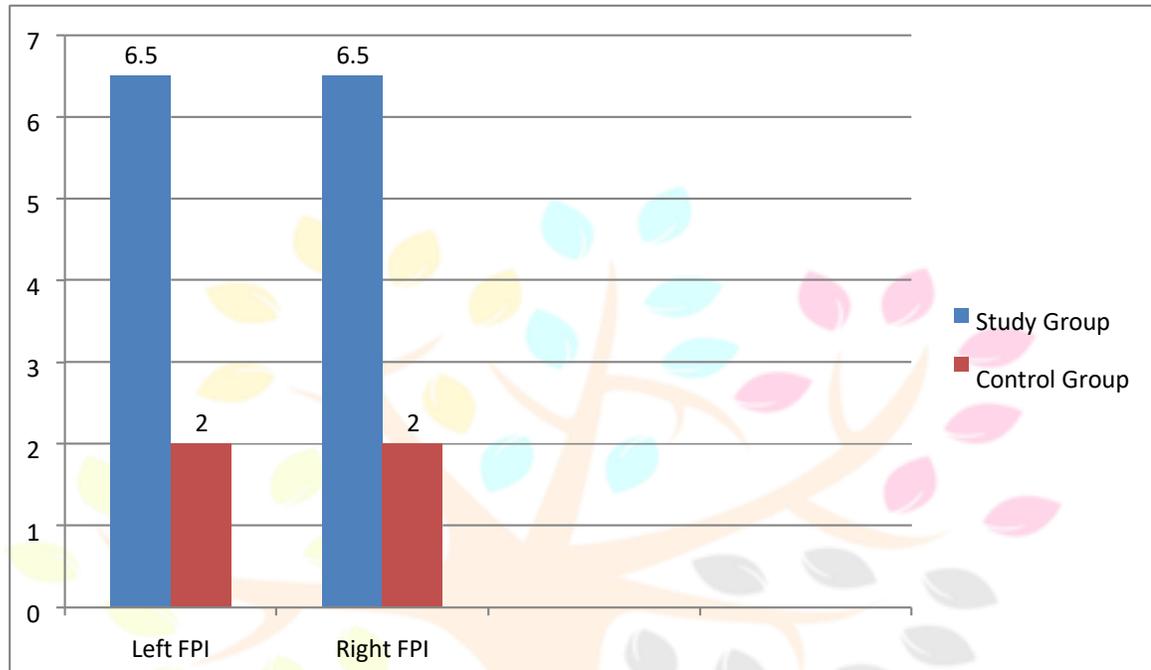
TABLE: 2: The above table shows the mean and standard deviation of weight, height and body mass index in between both the groups.

TABLE: 3: COMPARISON OF TOTAL FOOT POSTURE INDEX**SCORE BETWEEN BOTH GROUPS**

	Group	N	Media n	Minimum	Maximum	z value	P Value
Total FPI score Left leg	Study group	30	6.50	-2	11	-5.202	p<0.001
	Control group	30	2	-2	6		
Total	Study group	30	6.50	-2	10		

FPI score	Control group	30	2	-1	6		
Right leg						-5.089	p<0.001

TABLE: 3: The above table shows the comparison between the median of the total foot posture index score between both the groups. Because the p value is 0.01, the difference between the two groups is statistically significant



GRAPH: 2: THE ABOVE GRAPH SHOWS THE MEDIAN OF LEFT AND RIGHT FOOT POSTURE INDEX TOTAL SCORE IN BOTH STUDY AND CONTROL GROUP.

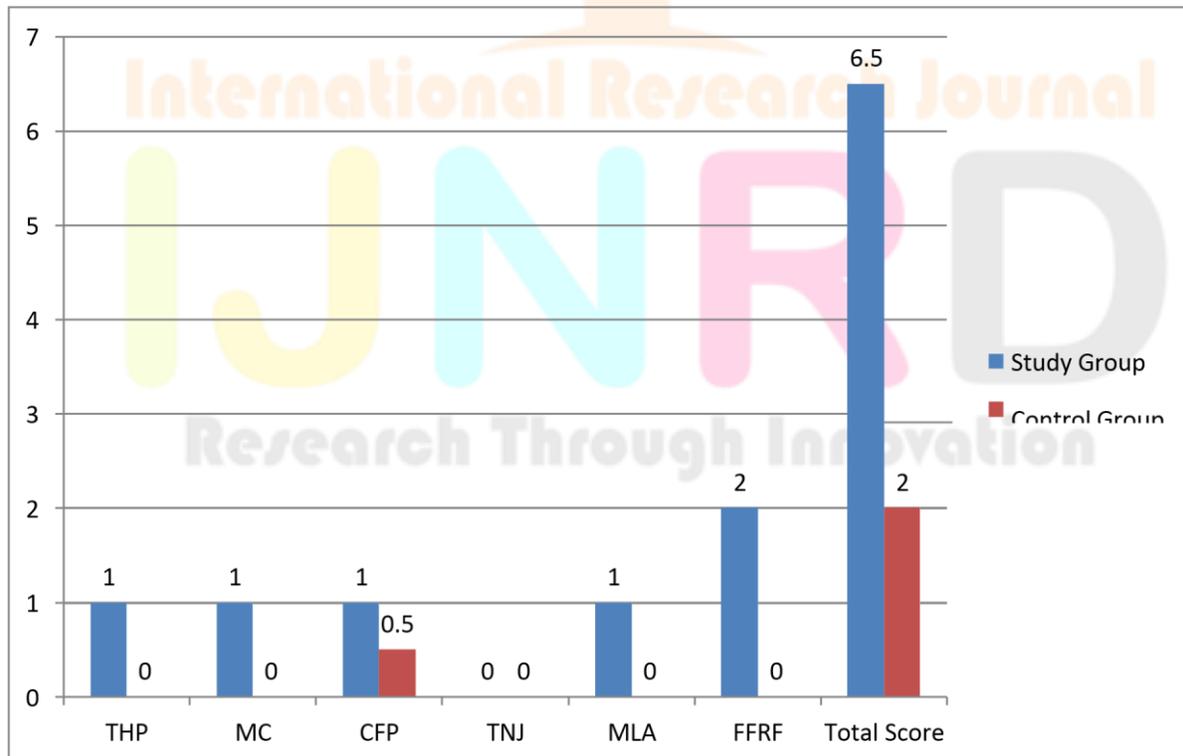
The median of the total FPI score of study group was 6.5 and the control group was 2 which shows that the study group has pronation of feet as compared to the control group.

TABLE: 4: COMPARISON OF THE MEDIAN OF LEFT FOOT POSTURE INDEX SCORES OF BOTH THE GROUPS

	Groups	Median	Minimum	Maximum	z value	p value
Talar head palpation	Study group	1	-1	2	-4.194	p<0.001
	Control group	0	-1	1		
Malleolar curvature	Study group	1	-1	2	-4.767	p<0.001
	Control group	0	0	2		

Calcaneal frontal plane position	Study group	1	-1	2	-3.795	p<0.001
	Control group	0.5	-1	1		
Talonavicular joint prominence	Study group	0	0	2	-2.668	0.008
	Control group	0	0	1		
Medial longitudinal arch	Study group	1	-1	2	-2.908	0.004
	Control group	0	-1	1		
Forefoot on rear foot	Study group	2	-1	2	-3.674	p<0.001
	Control group	0	-1	2		
Total score	Study group	6.5	-2	11	-5.202	p<0.001
	Control group	2	-2	6		

TABLE: 4: The above table shows the comparison of mean of LEFT foot posture index scores of both the groups. It also shows the z value and p value of each sub set. The significance is set at p<0.05.



GRAPH: 3: THE ABOVE GRAPH SHOWS THE COMPARISON OF THE MEDIAN OF LEFT FPI SCORES OF BOTH THE GROUPS

The median of left FPI of the study group is 6.5 and control group is 2 which shows that the study group had pronated feet as compared to the control group

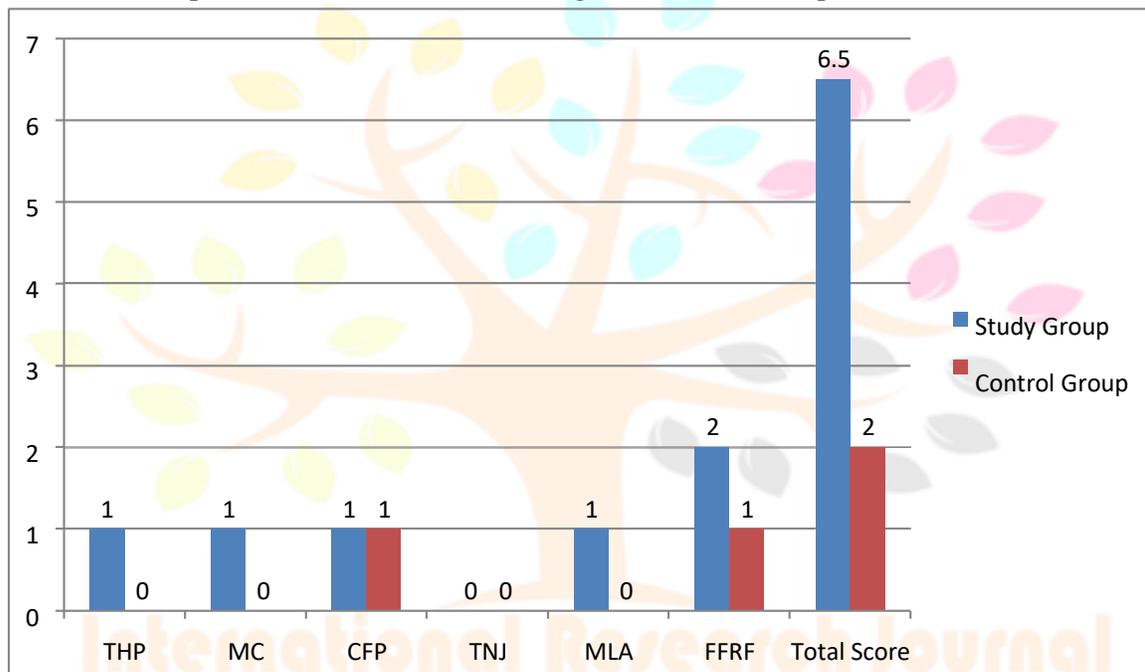
TABLE: 5: COMPARISON OF THE MEDIAN OF RIGHT FOOT

POSTURE INDEX SCORES OF BOTH THE GROUPS

	Groups	Median	Minimum	Maximum	z value	p value
Talar head palpation	Study group	1	-1	2	-4.174	p<0.001
	Control group	0	0	1		
Malleolar curvature	Study group	1	-1	2	-4.953	p<0.001
	Control group	0	0	2		
Calcaneal frontal plane position	Study group	1	-1	2	-3.468	0.001
	Control group	1	-1	1		
Talo navicular joint prominence	Study group	0	0	2	-2.407	0.16
	Control group	0	0	1		
Medial longitudinal arch	Study group	1	-1	2	-2.641	0.008
	Control group	0	-1	2		
Forefoot on rear foot	Study group	2	-1	2	-3.873	p<0.001

	Control group	1	0	2		
Total score	Study group	6.5	-2	10		
	Control group	2	-1	6	-5.089	p<0.001

TABLE: 5: The above table shows the comparison of mean of RIGHT foot posture index scores of both the groups. It also shows the z value and p value of each sub set. The significance is set at p<0.05.



GRAPH: 4: THE ABOVE GRAPH SHOWS THE COMPARISON OF THE MEDIAN OF RIGHT FPI SCORES OF BOTH THE GROUPS

The median of right FPI of the study group is 6.5 and control group is 2 which shows that the study group had pronated feet as compared to the control group

Our study compared the foot posture between the Bharatanatyam dancers and age matched control group. The data was analyzed using Mann-Whitney U test. The level of significance was kept at p<0.05. The statistical software namely SPSS 20.0 was used for the analysis of the data.

Total of 27 females and 3 males were taken in each group for comparison. Table no 1: The mean age of both groups is 21.1 years old, with a standard deviation of 3.11 years. This demonstrates that in terms of age, both groups were similar in nature.

Table no 1: show comparison of total foot posture index score between (left fpi vs right fpi) study group

Table no. The mean and standard deviation of demographic data, such as height, weight, and BMI, are shown in Figure 2.

Table no 2: The entire foot posture index score of both groups is compared in Table No. 3.

The study group's median left Foot posture index was 6.5, while the control group's was 2.

. The z value between the two groups for left FPI was -5.202 with p value <0.001. Similarly the median of the right Foot posture index was 6.5 in the study group and 2 in the control group. The z value between the two groups for right FPI was -5.089 with p value <0.001. Hence the primary findings revealed that Bharatanatyam dancers have pronation of foot when compared to the age matched control group.

Table no. 4 and 5 shows the comparison of mean of LEFT and RIGHT foot posture index scores of both the groups respectively. It also shows the z and p value of all the six individual components of FPI. Thus the individual scores of the components also show that the study group had foot pronation when compared to control group. These values are predicted in graphs 2 and 3.

DISCUSSION

The aim of the study was to compare the foot posture between Bharatanatyam dancers and age matched control group using the Foot posture index. It was hypothesized that a difference in foot posture would be seen between the subjects of the two groups. The study group's median left Foot posture index was 6.5, whereas the control group's was 2. The z value between the two groups for left FPI was -5.202 with p value <0.001. Similarly the median of the right Foot posture index was 6.5 in the study group and 2 in the control group. The z value between the two groups for right FPI was -5.089 with p value <0.001. Hence the primary findings revealed that Bharatanatyam dancers have pronation of foot when compared to the age matched control group. The individual components of foot posture index also showed an increased pronation with ($p \leq 0.05$).

Foot posture has long been assumed to alter the lower limb's mechanical alignment and dynamic function, and so may be connected to the development of musculoskeletal problems. Dancers' health issues are significant for several reasons. For starters, because most dancers begin training at a young age, they have the potential to have a long-term influence on their health. Second, the interplay of physical and aesthetic demands in dance can lead to a range of health issues, especially among dancers. Finally, as an occupational category, dancers have received minimal attention in the health literature⁴. Nancy J Kadel (2006) conducted a literature review.) It noted that severe positions caused by dancing result in both acute and overuse foot and ankle problems.

There are numerous factors that can lead to altered feet in Bharatanatyam dancers. A few can be stated as, repetitive tapping steps, maintaining the araimandali position all the time while dancing, and altered alignment and biomechanics of lower limb. Previously only one study has been done by V. Anbarasi (2012) to detect musculoskeletal problems in high performance Bharatanatyam dancers. When compared to the control group, injured Bharatanatyam dancers exhibited considerably ($p 0.05$) higher hamstring tightness. In comparison to injured dancers, normal dancers' right tendoachilles flexibility values were considerably higher ($p 0.05$) in sitting posture. The information gathered thus far relates to the lower extremity's flexibility.⁵ The current study has taken into consideration the feet of 60 subjects (30 Bharatanatyam dancers-study group and 30 age matched control group) using a valid and reliable measurement tool called Foot posture index. Till date there is a very little literature that compared the foot posture between the Bharatanatyam dancers and non-dancers using the foot posture index, to the best of researcher's knowledge. This study aims to provide clinically significant information regarding the subject's forefoot, mid foot and hind foot.

The foot posture index was measured in standing position which is the standard position for measurement as recommended by Redmond et al (2005) with the feet of the subject at eye level of the researcher.

There was a statistically significant difference in foot postures between the two groups, according to the data. Bharatanatyam dancers' foot posture had a pronation tendency. Even though the foot posture in the non-dancers group was statistically shown to be within the normal range, many of the subjects individually exhibited a high score on foot posture index, thus indicating a clinical tendency towards pronation.

This compensatory foot pronation found in Bharatanatyam dancers may be due to genu varum misalignment of the knee, which may result in compensatory foot pronation in order to keep the foot plantigrade during weight bearing. Cheryl Riegger-Krugh et al. (1996) claim that genu varus at the knee causes excessive subtalar pronation as a compensatory strategy to allow the medial heel to make contact with the ground. It can also cause forefoot valgus

Biomechanically as the hind foot pronates excessively, the midfoot or forefoot compensates by supination. If the midfoot does not then the forefoot should provide full compensation by supinating. According to the findings of the present study, the dancers showed excessive pronation of the hind foot as well as midfoot. Biomechanically as hind foot goes for pronation talus adducts and plantar flexes causing the navicular bone to drop leading to flattening of medial longitudinal arch. (Neely et al). Moreover the fore foot has also shown excessive pronation. The normal compensation probably could not occur due to the exposure of Bharatanatyam dancing leading to overuse.

Muscle imbalance could be one of the reasons too. A muscle imbalance due to lack of flexibility between the anterior and posterior leg muscles could also be a contributing factor for hind foot pronation. According to Bell et al, medial rotation of tibia and hind foot pronation is caused as a result of a muscular imbalance, characterized by tightness of the lateral head of the gastrocnemius and the peroneal muscle group, as well as weakening of the medial gastronomies, tibialis anterior and posterior muscles. However in this study the flexibility of the dancers was not assessed and hence becomes a limitation.

The precise reason for the occurrence of foot pronation in the control group has not been established so far. Factors like pathological tibia varum, tarsal coalition, equines deformity, proximal abnormalities due to tibia or femoral rotations, the change in foot position in the control group might be due to a variety of factors.

The current study had certain limitations. The sample size for the study was small. A larger sample size would have yielded more definite results. The methodology could have been strengthened further by blinding the assessor to the measurement of the values of the Foot Posture Index. An inter-rater reliability was not measured prior in the study. It would have helped in eliminating the subjectivity associated with the Foot Posture Index. The dominant leg44 should have been taken into consideration. Flexibility of the lower limb muscles wasn't taken into consideration. Also the height, weight and BMI were not matched.

This research can be carried forward and further in depth analysis can be done to establish a relationship between the foot posture and dance Using a bigger sample size might boost the study's clinical importance. An epidemiological survey may also be carried out using a larger sample size, to establish the prevalence of altered foot posture in Bharatanatyam dancers and no dancers. Also comparison of foot posture between the male and female Bharatanatyam dancers can also be carried out. A longitudinal or follow up study may help to show the incidence of prospective outcome from altered foot posture, such as low back pain, knee pain, heel pain, etc. This data may provide useful insight into preventing musculoskeletal injuries caused due to altered foot posture.

CONCLUSION

The individual components of FPI which measured midfoot, rear foot and fore foot also showed an increased pronation.

The foot is crucial in determining body alignment, particularly in the lower limbs. Variations in the height of the medial longitudinal arch have been demonstrated to be harmful. Changes in foot position have an impact on lower limb function. People with high arched feet are prone to injuries to lateral aspect of their knees, whereas people with flat feet show a tendency towards injuring or overusing the medial aspect of their knee joints. Hence early evaluation of the foot posture in the Bharatanatyam dancers is important to avoid repetitive stress injuries.

Foot pronation also leads to pelvic mal alignments leading to innominate rotations and myofascial trigger points.

If left undiagnosed and untreated, all of the structural responses to excessive pronation listed will eventually progress to joint degeneration. Biomechanical asymmetries in the body transmit abnormal forces and sustained stresses to the joints, resulting in micro trauma, cartilage wear, and osteophytes formation.

Hence, in the present study, it was seen that Bharatanatyam dancers have an excessive pronation of foot as compared to the control group

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