



## Original Research Article

## Balance in Bharatanatyam dancers and non-dancers: A comparative study

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## ABSTRACT

**Background and Objective:** Bharatanatyam is a classical Indian dance form that traces its roots to the 2nd century and is still one of the most popular and widely practised dance forms in India. It uses a lot of movements in different stances with superimposed limb movements. There may seem to be a logical link between balance and the practice of Bharatanatyam, but the paucity of research on this topic, especially concerned with Indian classical dance, thus prompted us to conduct the research to assess and have an objective measurement of comparison of balance between Bharatanatyam dancers and age- & gender-matched non-dancers.

**Materials and Methods:** A sample size of 50 Bharatanatyam dancers and 50 age and gender-matched non-dancers were assessed on the Neuro-Com Balance system for 3 parameters- weight-bearing (at 0, 30, 60 and 90 degrees of knee flexion), unilateral stance and Limits of Stability.

**Results and Conclusion:** Bharatanatyam dancers showed decreased sway velocity in unilateral stance compared to non-dancers. They also had quicker reaction times, higher movement velocity, better end-point and maximum excursion as well as higher directional control (in the Limits of Stability test) compared to the non-dancers.

The acquired results prove that trained Bharatanatyam dancers have better balance than age- and gender-matched non-dancers.

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## 1. Introduction

Bharatanatyam is a classical Indian dance form that traces its roots to the 2nd century and is still one of the most popular and widely practised dance forms in India.

This dance form is a beautiful amalgamation of emotions ('bhava'), rhythm ('taal') and melody ('raag') as accompaniments to the structural physical aspect of the dance.<sup>1</sup>

The repertoire of a classical Bharatanatyam dance piece may be varied, but always presents a dance synchronized with Indian classical music and usually depicts lyrical and rhythmic storytelling. The dancer's hands and facial gestures are used as the language to recite the legends or historical dramas and convey emotions. The footwork, body language, postures, musical notes, tones of the

vocalist, aesthetics and costumes all integrate to express and communicate the underlying text.<sup>1</sup>

The dancer deploys specific footwork, the body turns and postures to mark punctuations in the dance and the varied characters.<sup>2</sup>

Balance is the ability to maintain the centre of gravity of the body while minimizing the postural sway.<sup>3</sup> Balance is achieved through the coordination of multiple body systems- motor and sensory (visual, vestibular and somatosensory), cognition, task, environment, and other extrinsic factors. Maintaining balance isn't a matter of staying rigid or in one place, but by making small shifts and adjustments continually.

The basic posture of Bharatanatyam is called 'Araimandi'<sup>4</sup> which involves the dancer to assume a position of half-squat with hips externally rotated and knees flexed. This helps lower the body and Bharatanatyam makes

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use of this principle to provide the dancer with increased stability. Bharatanatyam dance adds limb movements by outstretching of the arms forward, upward, backward, etc. In some cases when the leg is outstretched as well, in different directions, the base of support also changes. Dance requires these subtle continual changes to ensure the dancer makes quick but smooth, complete moves. Bharatanatyam dance incorporates a lot of one leg positional holds (for poses), spins (single-legged or double), quick movement transitions, changes in positions and stances ('araimandi', 'mandi', 'samam', lunge positions, full sit, side sits etc.).

Balance is dynamic and affected by a variety of factors. Bharatanatyam dancers constantly change bodily stances, thus challenging balance.

Thus this topic of research aims to find out if there is any difference in the balance of trained Bharatanatyam dancers and age- and gender-matched Non-dancers between the age group of 15-25 years. In case of positive correlation, this can also have a greater impact in balance training techniques used in physiotherapy.

## 2. Materials and Methods

In this cross-sectional and observational study 50 Bharatanatyam dancers with matched age, gender and 50 non-dancers were included. Wilcoxon signed-rank test was used to analyse the data as the distribution was not normal.

### 2.1. Procedure

Approval was taken from the Institute's Ethics Committee and the participants were made to fill a consent form. The subjects were then divided into 2 groups of comparison -

Group A- consisting of the Bharatanatyam dancers fulfilling the inclusion criteria, and

Group B- consisting of non-dancers of comparable age.

Making use of the Balance Master (NeuroCom system), adhering to the protocol given.

The following parameters were then assessed:

1. Limits of Stability -move outward as directed in 8 directions.
2. Unilateral Stance -first with eyes open then with eyes closed. This was then repeated for the contralateral side as well.
3. Squatting/Weight-bearing- The participants were made to squat down keeping in mind the correct technique and posture, at different degrees of weight-bearing - 0, 30, 60, and 90 degrees of knee flexion.

### 2.2. Statistical analysis

The data were analyzed by the non-parametric test by using Wilcoxon signed-rank test. Significance was tested at  $p < 0.05$ .

## 3. Results

The data were analyzed and compared for each of the individual tests between the dancers and non-dancers. The values for the unilateral stance show the comparison between 'sway velocities' (m/sec) for the dancers and non-dancers.

The results for each of the tests are as follows-

### 3.1. Left unilateral stance (with eyes open)

### 3.2. Movement velocity

Measured as the velocity achieved by the respective groups to reach their end point (m/sec).

### 3.3. Maximum excursion

Is expressed as a percentage % of the total area to be covered from the starting to end point.

### 3.4. Directional control

Expressed as a percentage of stability maintained during the movement towards the target, compared and recorded for both the groups respectively.

## 4. Discussion

Bharatanatyam dancers undergo vigorous training in all the various aspects of the art form. Bharatanatyam dance incorporates a lot of one leg positional holds (for poses), spins (single-legged or double), pivot turns, quick movement transitions, changes in positions and stances ('araimandi', 'mandi', lunge positions, full sit, side sits etc.). This may explain their better performance in tests of unilateral stance.

As a dynamic art form, Bharatanatyam utilizes various poses for a depiction that have a unilateral stance, balancing on the toes in full squatting (Mandi pose), and quick changes in posture that require rapid weight shifts. Different steps require movements in and out of the base of support with different upper and lower limb movements, in turn causing continual shifts of the centre of gravity while dancing. It also requires strong postural control to be maintained while holding onto certain positions, for example, poses of Shiva, etc. This helps to train for better stability thus may help decrease sway velocity while holding onto certain positions (Tables 1 and 2).

Good balance is also required to make swift movements, smooth transitions and weight shifts from one foot to the other during dance steps. Thus reaction time and movement velocity show better readings for dancers compared to non-dancers (Tables 3 and 4). This correlates with the study by Lin CW, et al, in ballet dancers that show novice dancers have slower reaction times than trained dancers.<sup>5</sup>

**Table 1:** Descriptive data summary of left and right unilateral stance (ULS) with eyes open (sway velocities m/sec)

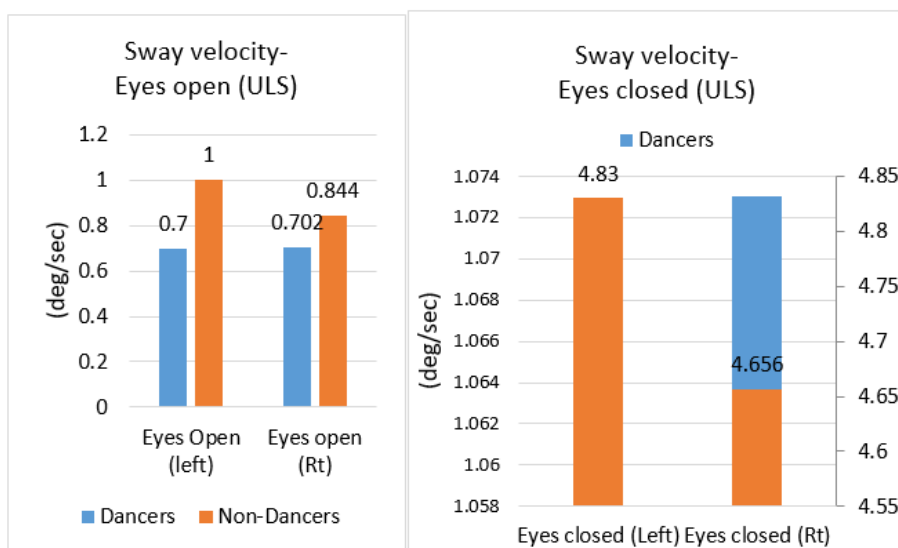
Parameter	Dancers		Non-dancers		Difference	
	Left	Right	Left	Right	Left	Right
Mean:	0.7560	0.7020	0.9420	0.8440	-0.1860*	-0.1420
Std deviation:	0.1358	0.1478	0.3648	0.1656	0.3603	0.2295
Lower 95% CI:	0.7174	0.6600	0.8382	0.7969	-0.2885	-0.2073
Upper 95% CI:	0.7946	0.7440	1.046	0.8911	-0.08351	-0.0767

\*Differences were significant p<0.001 for the left and significant p<0.01 for the right side

**Table 2:** Descriptive data summary of left and right ULS with eyes closed

Parameter	Dancer		Non-dancers		*Difference	
	Left	Right	Left	Right	Left	Right
Mean:	1.064	1.032	4.830	4.026	-3.766	-2.994
Std deviation:	0.1241	0.1435	3.440	2.216	3.432	2.224
Lower 95% CI:	1.029	0.9912	3.851	3.396	-4.742	-3.627
Upper 95% CI:	1.099	1.073	5.809	4.656	-2.790	-2.361

\* significant at p<0.01 for the left and significant at p<0.01 for the right



**Fig. 1:** Shows that irrespective of the leg (left or right), unilateral stance of the non-dancers showed more sway velocity, i.e. instability is reflected, with unilateral stance with eyes open

**Table 3:** Descriptive data summary of reaction time

	Dancers	Non-dancers	*Difference
Mean:	0.9537	0.5878	0.3659
Std deviation:	0.2246	0.1156	0.2446
Lower 95% CI:	0.8898	0.5549	0.2963
Upper 95% CI:	1.018	0.6207	0.4355

\*p< 0.0001

**Table 4:** Descriptive data summary of movement velocity

	Dancers	Non-dancers	*Difference
Mean:	5.326	3.382	1.944
Std deviation:	1.388	0.8062	1.570
Lower 95% CI:	4.931	3.153	1.497
Upper 95% CI:	5.721	3.612	2.390

\*P value is < 0.0001

**Table 5:** Descriptive data summary of maximum excursion

	<b>Dancers</b>	<b>Non-dancers</b>	<b>Difference</b>
Mean:	98.233	76.632	21.601
Std deviation:	4.806	9.090	10.045
Std error:	0.6797	1.286	1.421
Lower 95% CI:	96.865	74.046	18.743
Upper 95% CI:	99.600	79.218	24.458

**Table 6:** Descriptive data summary of directional control-

	<b>(Dancers)</b>	<b>(Non-dancers)</b>	<b>Difference</b>
Mean:	86.013	76.506	9.507
Std deviation:	3.672	5.035	7.055
Lower 95% CI:	84.968	75.073	7.499
Upper 95% CI:	87.057	77.938	11.514

Multiple movements also require moving out of the base of support, thus activating and training the core muscles as well.<sup>6,7</sup> As the dancers are also required to stretch out their limbs to a maximum of their abilities, this trains them for movement of the COG on the edges of the Base of support or outside, all while maintaining the stability of posture. This accounts for better excursion capacities (maximum and endpoint excursion percentages) with added stability seen in Bharatanatyam dancers as the readings show greater coverage of the area (Table 5) in their limits of stability.<sup>8</sup>

The additional fast-paced limb movements, super added on a base of good postural stability, place a further challenge to train and develop dynamic balance. This causes continual changes in the level of the COG of the body. These factors help provide constant challenges to the balance systems.

It is usually seen that practising and training makes for better balance and ease of dance.<sup>9</sup> In addition to this, the development of balance is also positively stimulated as all of these activities are performed in a random sequence that further challenges the balance maintaining systems, which is also an important principle of motor learning ('Random v/s blocked').<sup>10</sup>

As Bharatanatyam movements and poses result in better balance some of these poses and positions may be considered to be used for balance training for a variety of patients and pathologies keeping in mind the individual's assessment, cognition and level of involvement.

## 5. Conclusion

Bharatanatyam dancers have decreased sway velocity in unilateral stance (balancing on one leg) compared to non-dancers, and have quicker reaction times, higher movement velocity, better end-point and maximum excursion as well as higher directional control (in the limits of stability test) compared to the non-dancers.

The acquired results prove that trained Bharatanatyam dancers have better balance than age- and gender-matched

non-dancers.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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