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Co-Relation betweeen Core Endurance and Balance in Bharatnatyam Dancers: A correlational study

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Abstract
Aim: The aim of the study is to determine the Relationship between core endurance and balance in Bharatnatyam Dancers.
Relevance of study: The study helps us to assess the Relationship between core endurance and balance in Bharatnatyam Dancers.
Methodology: To conduct this correlational study, subjects will be taken according to the inclusion and exclusion criteria. Prior to starting the study, the procedure must be explained and informed written consent form will be taken from the subjects. Subjects will be taken in a single group. Two outcome measures will be used. Plank test used to assess the core endurance and Star Excursion Balance Test used for assessing balance. The subjects will be explained about the study and given information about how the study will benefit them.
Results: Among 81female Bharatanatyam dancers (age group 11-25 years) were collected for the study and analyzed. The results show Positive correlation between core endurance and balance as the value of r was r = 0.1615 and value of p was p= < 0.0001, considered extremely significant.
Conclusion: There was a positive correlation between core endurance and balance.

Keywords: Bharatnatyam dancers, core endurance, balance, Y excursion balance test, plank test)

Introduction

In India, various facets of performing arts are all pervading. They bring color and joy to numerous festivals and ceremonies. They are reaffirming the faith of the people in their heritage. These facets have been responsible for sustaining the long continuities of ancient traditions. The classical arts thus became distinct from their folk roots [1]. Dance is defined as a conscious effort to create visual designs in space by continuously moving body through a series of poses and pattern tracing. The movement must also be sync to a. modern dance is characterized by barefoot dancing, asymmetry and personal choreographic or dance style [1].

Dance is not only a performing art, but a highly rigorous athletic sport. Dance is designed to look aesthetically pleasing, while often performed at extreme ranges of motion [2]. Dance are probably the most elemental art forms, spontaneously expressing the entire garment of human emotions and experiences. There are tribal belts throughout India, and although each tribe has its own distinctive music and dances, they all share a similar form, with men and women forming separate rows with linked arms and executing intricate leg movements in a gradually increasing tempo [1].

Dance is defined as a conscious effort to create visual designs in space by continuously moving body through a series of poses and pattern tracing [1].

In India there are various forms of classical dances, Bharatnatyam is one of them. Various Dance are reaffirming the faith of the people in their heritage. These facets have been responsible for sustaining the long continuities of ancient traditions. Dance is not only a performing art, but a highly rigorous athletic sport.

Bharatnatyam Dance

Tamil Naidu women perform Bharatnatyam

Bharatnatyam leans heavily on the Abhinaya is the art of expression in Indian aesthetics. {Abhinaya (Sanskrit Abhi-'towards '+nii- 'leading/guide') More accurately it means "leading an audience towards" the experience (bhava) of a sentiment (rasa).} In Bharatnatyam the aspect of dance the Nritya, where the dancer expresses the sahitya through movement. Shabdam follows the Jatiswaram in a Bharatnatyam dance performance. Bharatnatyam Dance is over 2000 years old. Bharatnatyam dancers' performance combines the grace and beauty of the art of dance, with the strength and endurance of a highly trained athlete [1].

Bharatnatyam Dancers are expected to perform a diverse form of techniques. Judged on the individual execution of difficult technical skills while performing with precision and synchronization. Each technical skill requires significant motor control, particularly of the extremities, but also spinal stability provided by the trunk musculature hereafter referred to as the core. Bharatnatyam dancers experience a high incidence of injury due to the extreme physical demands of dancing. Many dance injuries are chronic in nature and occur in the lower extremities and low back. The body's core is frequently involved in aiding movements of dance [7]. The major muscles involved in core includes. The pelvic floor muscles, Transvers abdominis, Multi Fidus Internal and External Obliques, Rectus abdominis, Erector spinae [Sacro spinalis] especially the longissimus thoracis, the diaphragm.

Notably, breathing including the action of the diaphragm, can significantly influence the posture and movement of the core [8].

Core Endurance

Core endurance is defined as the ability to maintain a position or perform multiple repetitions. Core endurance has been used in preventing injuries in dancers and in rehabilitation settings [9].

Balance: Balance is defined as the stability to control the body mass or Centre of gravity to the base of support in order to maintain an upright posture or a functional equilibrium in dynamic activities [10].

Balance and neuromuscular stability deficits also increase lower extremity injury risk [12]. Balance is the ability to maintain postural stability while standing on one leg and performing a reach with the other leg as described when performing the Star Excursion Balance Test (SEBT) [13, 14]. Relationship between Core Endurance and Balance has not been extensively discussed in previous dance literature. Understanding the Relationship between core endurance and injury risk is important to help reduce dance injury incidence and improve performance.

Materials and Methods

The following study was An Observational type of Correlation study. The sampling population was collected by purposive sampling method. The minimum sample size of the research was 79 candidates Female Bharatnatyam Dancers Having experience of 3 and more than3 years. The study was conducted in Bharatnatyam dance classes of Dhule. The duration of study was 6 months.

The sample size was calculated by the following formula.

Formula:

$$N = \frac{Z^{12}S^{2}}{d^{2}}$$

The Criteria of selection of participants was done based on Inclusion Criteria which included the participants Voluntary willing to participate, Female Bharatnatyam Dancers Having experience of 3 and more than3 years of experience.

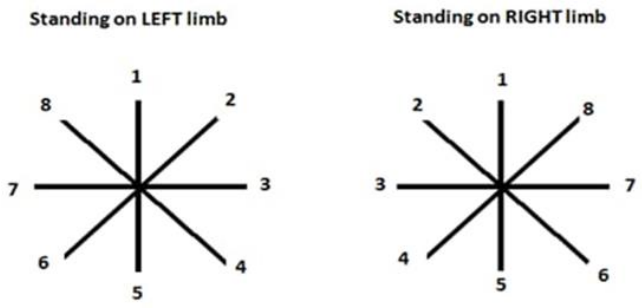
The Bharatnatyam dancers should of age 10 to30 year the participants having Any neurological or musculoskeletal injury affecting their mobility or balance were excluded

Procedure

To conduct the following study Subjects will be taken according to the inclusion and exclusion criteria Prior to starting the study, the procedure must be explained and informed written consent form will be taken from the subjects. Subjects will be taken in a single group. They will be explained about the study and given information about how the study will benefit them.

Balance was assessed by Star excursion balance test. Star Excursion Balance Test (Lower Quarter) Lower quarter balance will be measured using the SEBT. The SEBT uses a single-leg stance and requires participants to perform a maximal reach of the opposite leg along marked lines while keeping the stance leg placed stable at the centre, and then return to the initial upright posture without losing balance [17].

Balance would be measured via the Star Excursion Balance Test (SEBT) – and specifically – the Y-balance components of the test using previously published methods. The test required participants to first assume a single-leg stance, and then maximally reach along marked lines using the other leg while keeping the stance leg stable at the centre of a grid, and then return the reach leg back to the centre without losing balance. SEBT scores were combined across all directions bilaterally and this composite score was used for analyses [15, 16].



For this study, participants performed reaches in three reach directions: anterior, posterolateral, and posteromedial (Figure: 1A, 1B, 1C) in that order.



Fig 1A: Anterior **Fig 1B:** Postero lateral **Fig 1C:** Postero medial

Core endurance

- Core endurance was measured by using plank test in three different positions.

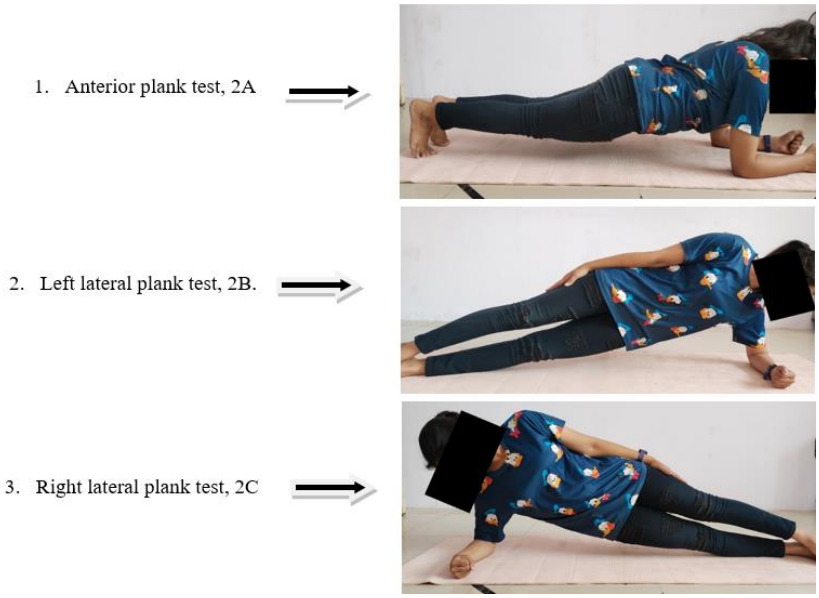


Fig 2: Prone plank test /Anterior plank test

- Anterior plank test also known as Prone Plank test.
- The anterior plank test consisted of having the participants maintain 900 between elbows and the trunk.

1. Participants assumed a push-up posture in down position,
2. Legs together,
3. Lower leg in contact with mat,
4. With ankles plantar flexed,
5. Back straight, hands shoulder width apart,
6. Head up.
7. Time recording was stopped when any segment of the participants' body did not remain parallel to the floor.
8. Only the elbows and toes were allowed to be in contact with the mat.
9. Any corrections that had to be made were in a 3-second period otherwise the test was terminated. The average score of the test was used for analysis.

Fig 3: Left lateral plank test

1. Left lateral plank test: Participants placed their feet one on top of the other,
2. Their right arm perpendicular to the floor,
3. With the elbow resting on the mat,
4. The left arm across the chest with the left hand on the right shoulder.
5. The time point when the participants could not maintain a straight line between the trunk or lower body (thigh or shank) segments on visual observation was recorded by the investigator.

Fig 4: Left lateral plank test

Right lateral plank test: [fig5] [participants use position same as left lateral plank test]
The average score of the test mentioned was uses for analysis.

Fig 5: Right lateral plank test

Results

All data was collected and entered in Microsoft Excel. Descriptive statistics were applied to categorical variables where mean, and SD was expressed in %. Mean and SD were computed.
All the results were shown in tabular as well as graphical format to visualize the statistically significant difference more clearly.

Normality of the data was checked using Shaprio –Wilk test. As the p-value is less than or equal to the significance level (0.05), we conclude that our data does not follow a normal distribution.
Hence, Spearman's Rank correlation coefficient test (non-parametric) was used to find correlation of core endurance and balance.
All the data was analysed using "Graph pad Instat version3.10" 81 female participants (age group 11-25 years) were collected for the study and analyzed. The mean age of participants was 15.90 ± 2.55.

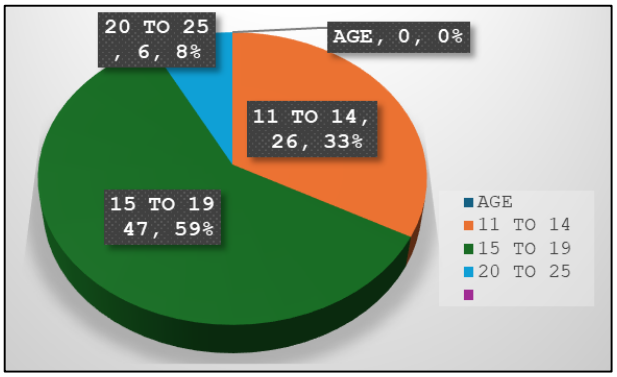


Fig 6: Age Distribution

Inference: Out of total 81 participants
47 % of age 15 years;59% of age19years
26% of age 11 years;33% of age 14 years
6% of age 20 years; 8%of age 25 years

Core endurance

- Core endurance was measured using PLANK TEST
- Which had 3 components.

1. Anterior prone plank test.
2. Right lateral plank test.
3. Left lateral plank test.

Table 1:

Plank Test	Mean	SD
Anterior Prone Plank Test	47.85	18.08
Right Lateral Plank Test	18.74	4.92
Left Lateral Plank Test	19.1	5.48
Average of All Three Test	28.56333	9.493333

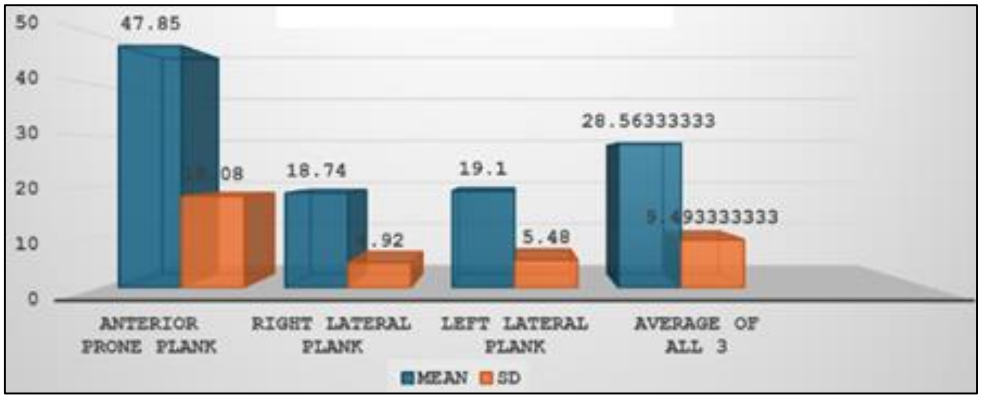


Fig 7: Core Endurance: Plank test

Inference: The mean of anterior plank was 47.85±18.08, right lateral plank was 18.74±4.92, left lateral plank was 19.1±5.48. The average of all three components was found to be 28.56±9.49.

Balance

- Balance was assessed by using Y excursion balance test.
- Y excursion balance test uses Y components of Star excursion balance test (SEBT).
- It has 3 reaches:

1. Anterior reach.
2. Posterolateral reach.
3. Posteromedial reach.

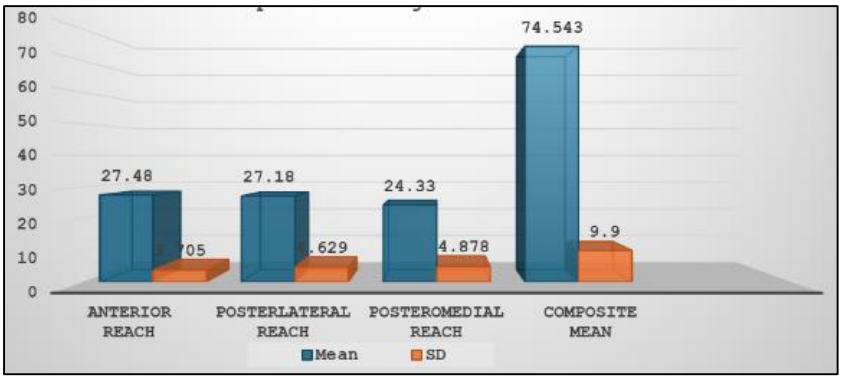


Fig 8: Y excursion components of right side

Table 2: Y excursion components of right side

	Mean	SD
Anterior reach	27.48	3.705
Posterolateral reach	27.18	4.629
posteromedial reach	24.33	4.878
Composite mean	74.543	9.9

Inference: The mean of right anterior reach was 27.48±3.70, posterolateral reach was 27.18±4.62and posteromedial reach was 24.33±4.87
The Composite mean of right side was 74.54±9.9

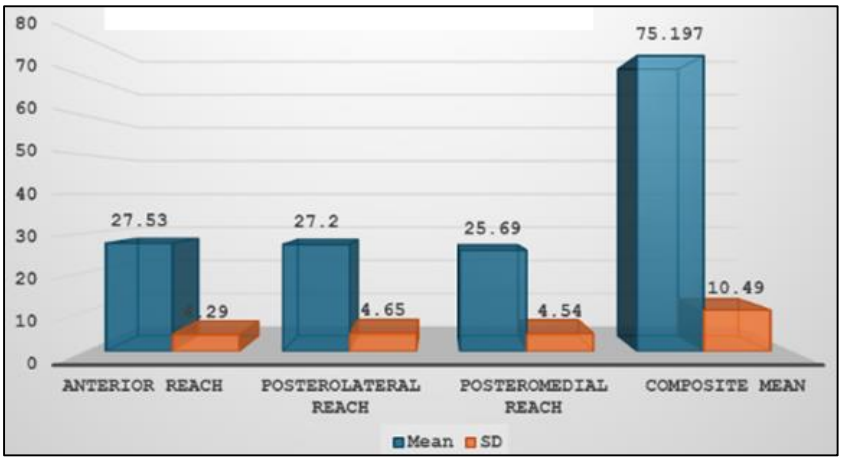


Fig 9: Y excursion components of left side

Table 3: Y excursion components of left side

	Mean	SD
Anterior reach	27.53	4.29
Posterolateral reach	27.2	4.65
Posteromedial reach	25.69	4.54
Composite mean	75.197	10.49

Inferences: The mean of left anterior reach was 27.53±4.29, posterolateral reach was 27.2±4.65and posteromedial reach was 25.69±4.54
The Composite mean of right side was 75.197±10.49.

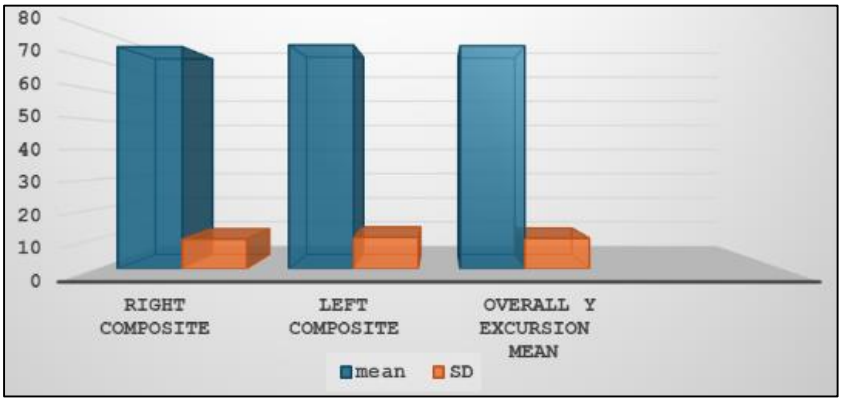


Fig 10: Composite mean of Y excursion balance test

Table 4: Composite mean of Y excursion balance test

	Mean	SD
Right Composite	74.54	9.9
Left Composite	75.197	10.498
Overall Y Excursion Mean	74.85	10.19

Inference: The right composite mean of y balance test was 74.54±9.9and left composite mean of Y balance test was 75.197±10.498. The mean of overall Y excursion balance test was 74.85±10.19.

Correlation between Core Endurance and Balance

The correlation between core endurance with balance was analyzed by using spearman correlation test.

The results show Positive correlation between core endurance and balance as the value of r was r = 0.1615 and value of p was p= < 0.0001, considered extremely significant.

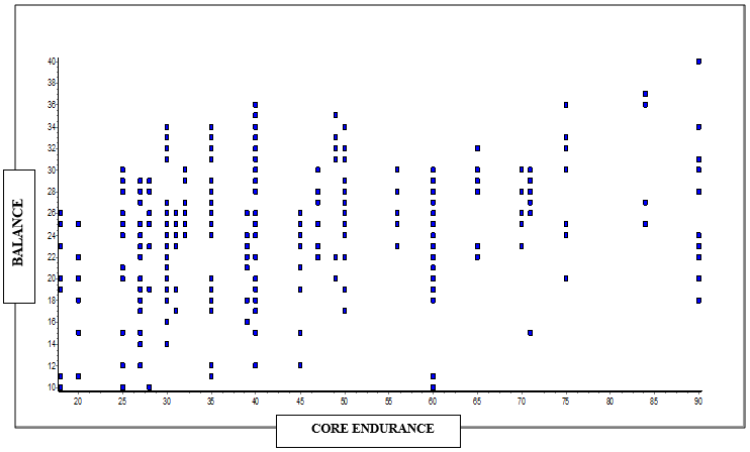


Fig 11: Core Endurance

Discussion

The present study aimed to assess the relationship between core endurance and balance in Bharatnatyam Dancers.

The resulted that there was Positive correlation between core endurance and balance as the value of r was r = 0.1615 and value of p is p= < 0.0001, considered extremely significant.

The study participants the anterior core endurance was 47.85±18.08, right lateral core endurance was 18.74±4.92, left lateral core endurance was 19.1±5.48 s. The average of all three components was found to be 28.56±9.49.

The right composite mean of y balance test was 74.54±9.9and left composite mean of Y balance test was 75.197±10.498.

The mean of overall Y excursion balance test was 74.85±10.19.

Found that 6-week core stabilization training resulted in significant increase in three directions of the SEBT (approximately PM 6%, M 12%, and AM 5%) in high school track and field athletes. Type I fibers (slow twitch) are slow to contract and can sustain muscular contraction for longer time. This factor makes them ideal for endurance type of events. All four muscle layers of the anterior abdominal wall contained a mosaic of Type I and Type II fibers. The proportion of Type I and Type II I1 fibers are about equal in all muscle layers. The even distribution of fiber types indicates a functional capacity for both fast contractions and endurance in each muscle layer. There are large differences in fiber type distribution between individuals which indicate differences in performance capacities [25]. which coincides with my present study.

Discuss that individuals with high levels of core muscular endurance were more likely to have good overall core stability and be less prone to LBP. These findings show that increases in core muscular endurance may increase spinal stabilization and have a protective effect on the incidence of LBP. However, to increase trunk and core muscular endurance, especially in children, effective core conditioning programs must be implemented in accessible settings [19]. This supports my study.

Examined core muscle activation during single leg squats and reported that participants who voluntarily activated their core musculature had improved frontal plane hip and knee kinematics than those who did not activate their core. 43 The

discrepancy between these prior studies and the current findings may be due to the differing tasks. Overall, when combining prior findings with the findings of the current study, it appears that further investigations are needed to clearly determine if core musculature endurance and SEBT performance are related to each other [15] which coincides with my present study.

The Y excursion balance test is used by some therapists to assess dynamic balance. It has been proposed that the test measures dynamic balance, requiring patients to maintain balance on a single limb, while manipulating the other limb. This test requires the subject to reach along a previously marked line with one leg while standing on the other leg. This reaching task is done along four different diagonal lines in four different directions. The distance reached in each direction is recorded separately and the four individual scores are interpreted as a representation of dynamic balance and offer clinicians a practical alternative for assessing dynamic balance [25].

Fair positive correlations existed between left lateral core endurance and right posteromedial SEBT scores but not in other directions consistently. The authors are unsure of this finding as the core should be active bilaterally during dynamic lower extremity movements Still, from the limited correlations observed, it appears that that include lateral core musculature training programs could potentially improve posteromedial direction balance.

Dancers have a significantly higher percentage of type I fibers. They have a significantly lower percentage of both type IIA arid IIB fibers than sedentary untrained or moderately trained women. They are like endurance-trained female runners also in this respect [15]. Current study showed the positive correlation between core endurance and balance this could be because endurance in dancers can be attributed to conversion of type II (fast) fibers to type I (slow) muscle fibers, slow fibers have less fatigability compared with fast fibers.

Hence forth it was supportively approved from the current study that for better dynamic stability in Bharatnatyam dancers there must be good core endurance and vice versa.

The conclusion of the study was positive correlation between core endurance and balance. The study did not consider professional dancers only which was limitation to the study.

Future Scope

In future scope, further research can be done on correlation of core stability and balance. Intervention strategies to improve core endurance and balance in Bharatnatyam dancers can be conducted.

Clinical Implication

This study was designed to assess correlation of core endurance and balance in Bharatnatyam dancers which will serve to be a primary prevention of ankle and lower limb injuries. Improving the core endurance can improve balance in Bharatnatyam dancers. So, the core endurance and balance training must be given for Bharatnatyam dancers which can enhance their performance skills. It can help in evidence-based practice.

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