‘Dance in Fitness Culture
An Experimental Investigation’

Ph.D. thesis
submitted to the

University of Hyderabad

For the Award of the
Degree of

Doctor of Philosophy in Dance

By

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June - 2019

C E R T I F I C A T E

This is to certify that the thesis entitled **"DANCE IN FITNESS CULTURE - AN EXPERIMENTAL INVESTIGATION** Submitted by **MALLESH EDUGANI** bearing registration number **14SNPD03** in partial fulfillment of the requirements for award of Doctor of Philosophy in the School of Sarojini Naidu School of Arts and Communication in a bonafide work carried out by him/her under my supervision and guidance.

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2. **Internataonal Journal of Health, Physical Education and computer Science in Sports S** (ISBN/ISSN Number **2231-3265**), Volume No.27 No.2 PP486 to 487 TITLE Effect of Excurse protocol intervention on the performance status of Bharatanatyam and Kuchipudi, July 2017 to Sep. 2017

and

B. Presented in the following conferences:

1. 3rd International conference by the Deportment of Applied psychology of Pondicherry University and 6th InSpa International Conference, 13-15 October 2016.
2. Procedings of Three-Day International Conference on physical Education, sports and Fitness. 27th to 29th January 2017.
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DECLARATION

I, Edugani Mallesh, hereby declare that this thesis, titled “Dance in Fitness Culture – An Experimental Investigation’, has been carried out by me independently in the Department of Dance, Sarojini Naidu School of Arts and Communication, University of Hyderabad under the supervision of Prof. M. S. Siva Raju. I also declare that this work is original and has not formed the basis for the award of any degree, diploma, fellowship and associateship or similar title of any University. A report on plagiarism statistics from the University Librarian is enclosed.

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Acknowledgements

Undertaking this PhD has been a truly life-changing experience for me and it would not have been possible to complete without the support and guidance that I received from many people whom I remember always in my life time are:

I would like to express my deep gratitude to Prof. M. S. Siva Raju sir for his patient guidance, motivation, enthusiastic encouragement and useful critiques of this research work. I could not have imagined having a better guide/supervisor and mentor for my Ph.D. study.

I would also like to express my sincere thanks to Dr. Rajasekar K.V, (one of the doctoral members) Director of physical Education, University of Hyderabad for his help in providing scientific method of exercises for my experimental study and collecting the data and Data Analysis.

I thank Dr. Joly Puthussery Deportment of folk culture studies, University of Hyderabad for his continuous support in knowledge sharing and timely given appropriate remarks during my Ph.D.

I would also like to thank Prof. Anuradha Jonnalagadda, Deportment of Dance, Prof Aruna Bikshu for helping me in finalizing of dance components which I used in my experimental study. And I also thank Prof. P Ramalinga Sastry for his support.

A special thanks to Dr. LVN Bushan Rao, faculty, Pondicherry University for his wonderful inspirational words during my PhD work

I wish to thank Samson Mallavarapu Assistant Director of Physical Education for his help during my field work and data collection. And I thank Basha sir, Sai Abhinav and Thrinadh who helped me during experimental sessions,

I wish to thank Mr. Sathish Gokara and the students of Srees Fitness Studio who frequently allowed me to do my experimental work in their studios.

This PhD study would not have been possible without Sathish Thipparapu and his family who gave me inspiration and giving all support to me for my PhD.

I would like to thank all dance gurus and performers who immensely helped me during answering questionnaires through mails are Barbara Vijayakumar, Charanya Grusathya, Devraj Patnaik,Kiran Rathana, Nandhini Krishana, Nilema, Papiha Desai, Madhavi Puranam, Priyadarshini Ghosh, Unnikrishnana, Viji Iyer and Yashoda.

I specially thank Mr. Rajesh Thipparapu for giving wonderful hospitality in Pondicherry Central University and I also thank Sampath Tipparapu ,Odelu Mothukuri for their wonderful encouragement during my first paper presentation.

I thank all masters students of Department of Dance who studied during 2017 to 2019 for their timely support.

I would also like to express my heartfelt gratitude to Mother (Yadamma) and Father (Yakaiah), my sisters and in-laws Nirosha, Shylaja, Parsharamulu and Ashok for their continuous support.

And finally, to my dear wife Kiranmai, who has been supporting throughout this PhD work and without whom, I would not have been completed this wonderful academic work.

I thank staff of the department of dance. And I also thank all whoever helped me during my PhD study.

C O N T E N T S

CHAPTER I

INTRODUCTION AND BACKGROUND OF THE STUDY

This chapter depicts the background on which the premise of the topic of the present study depends and explains the different aspects like culture of dance in India, the relevance of dance to human existence, the required components for dance like fitness. This also tries to signify the essence of how the fitness got entwined into dance in a serious note. The major area of discussion certainly revolves around the Indian classical dances and some forms of folk dances. Discussion on the popular dances and the hybridization of dances may also be in the scope of this research. The presentation in this part of the study explains the significant importance that is attached for selection of the present topic. The discussion encompasses several arguments and counter arguments that might contribute for further research in this area.

Dance as an embodiment of culture:

Since time immemorial, the human beings have been very keen in indulging in some form of dance, and markedly the dance been considered as assimilated and inseparable aspect of human culture. Several civilizations existed on this earth before the present human era, and several authentic archeological and rhetorical evidences are available as testimony that dance is an important aspect of human culture. Some of such civilizations which contributed dance to the world are Egyptian, Hellenic, Peruvian, Indian etc. Authentic evidences available in Greece about the Pan-Hellenic dances are noteworthy and belonged to thousands of years ago. Evidences show that

dance has been instrumental in religious rituals and initially most of the dance forms of the human civilizations were rudimentary and limited for religious expressions and invocations. Even African ethnic groups had their own forms of dances for several occasions and most of these ethnic dances were for invocations of gods. Steadily the dance forms were evolved into highly matured and intricately structured too. Specially, the Indian classical dances have been very systematically structured and preserved for centuries. There may be other such dances belonging to several other regions.

The perspective that the origin of dance may be interlinked to religions might be acceptable, though social dancing also co-existed in human culture. Religious rituals consisted of dancing were probably meant to invoke and appease gods and generally may be accompanied with oral invocations and songs meant for religious gods. The evolution of dance and the consequences of such evolutionary trends brought significant cultural enlightenment. It is for sure that the ethos of Indian classical dances was derived roots from Hindu religion, as these Indian classical dances mostly depict for the story sequences of Hindu mythology. Leaving aside the ambiguous time line of Vedas and other Hindu religious scriptures, the content which clearly indicates that the Indian dances had divine origin may be accepted basing on these textual evidences. A fountain head and provenance in this regard is Bharata Muni's "Natya Shastra", in which there is a mention about a celestial dance form called Shiva Thandava, which is believed as the dance of Lord Shiva, a chief Hindu deity. Though the most of the songs described in Natya Sastra are Vedic songs, but some non-Vedic songs were also mentioned. It is difficult to say emphatically, that the

ancient Indian dance styles would resemble the present Indian Classical Dances in all aspects of dance. It may be presumptuous and assuming to equate the ancient Indian dance and the Present Indian classical dances like Bharatanatyam, Kuchipudi as they are at present. Some of the sculptures of Mohenjo-Daro and Harappa depict dances with different dance postures and the texts like Natyashastra might have derived inspiration from these. Nandikeshvara's Äbhinava Darpana" (**Mirror of Gesture**) is another very authentic source in Sanskrit, which mentions about the stage craft with respect to the gestures of the actors on the stage. There are several other ancient texts which are describing the ancient Indian dances, but it is difficult to assume things dynamically.

However, the ancient Indian dances were more towards religious in nature and most of the dances and styles were meant to depict the religious sequences for appeasement of gods or for description of mythological story sequences. The other stream of dance form that always existed in the human domain relate to the social form and may be termed as social dances. These may be religious or non-religious. Generally, these are identified as folk dances as they are of mostly non structured and less rigorous in style (***Ojasi Sukhatankar 2016***).

Now dance is globally considered as a segment of culture. Whatever may be the source of dance in any society, in general it has two attributes in it. These are Nritta and Abhinaya. Nritta describes the technical aspects of the dance and abhinaya relates to emotional aspects of dance. Hence, physical movement with related expression

makes the dance. Very rarely physical movement dominates in dancing when compared to expression and it may not lead to Rasa of the spectator. Interestingly, it is obvious the rasa of the dancer is also highly essential to derive the expected intensity of dance. Dance should become blissful and aesthetic experience for both dancer and to the spectator, and for attaining this various expressive gestures, mudras and movements are essential. Hence, dancer should perform the dance permeated by poise and with an essence of self-enjoyment (**Aparna *Mohanty and Pratik Vaishnavi 2016***).

Influence of changing trends in culture and hybridization of dance:

Change is imminent in any domain of human existence and it is also true to the domain of dance. As the times are changing the attitudes change and hence the new reflections in dance may surface. This is very well seen in Indian dance scenario starting from ancient times to the present Bollywood dance. It may be difficult to visualize and portray how the ancient dance forms looked like during Vedic period or much before. The revival of Classical Indian Dances with nomenclature like Bharatanatyam, Kuchipudi, Kathak, Kathakali, Manipuri etc. has brought very significant identify to India in terms of its culture.

These Indian Classical dances are highly sophisticated both in terms of nritta and abhinaya. Many a time they are very complex to understand to a common spectator, since most of the Indian classical dances portray the religious sequences. Bharatanatyam and Kuchipudi are highly expressive and very intricate movement

sequences, which requires extraordinary effort from the dancer for achieving the highest rasa (Aparna ***Mohanty and Rajiv R Sahay 2018***). It may be true, that the dances in India were brought down to very low level of esteem, especially during the medieval period. Devadasi system was one strong example and evidences show that the temple dancers were brought down to the level of concubines to temple priests, rules etc (***Archana Ganapthy)***. Revival during the pre-independence and post-independence period due to the efforts of persons like Balasaraswati, Rukmini Devi, Uday Shankar brought back the prestige and recognition to Indian classical dances (***Rajyalakshmi Seth. 2014***).

The dances with their comparatively slow but very graceful dance patterns could gain initial recognition globally, but could not really appease and assuage the common spectator, who would want certain rhythm and aesthetics for attaining emotional happiness. Even today, the western world look with awe and inspiration towards the Indian classical dances and are patronizing these dances very much. There have been several dance institutes and academies working for imparting and promoting the Indian classical dances among the western people.

Indian classical dances with their very astute and ingenious movement patterns involving different segments of the body like hands, fingers, legs, face and eyes bring lot of complexity to the performer. Every part of the body including torso are used extensively in all forms of the Indian classical dances. This presupposes the dancer of Indian classical dances of any form with excellent fitness both of physical and mental.

Some of the hand gestures and gestures involving the fingers with simultaneous facial expression requires extraordinary neuro muscular facilitation and neuromuscular coordination.

It is also imminent to discuss the dance trends of other parts of the world apart from Indian subcontinent. As mentioned earlier, the civilizations that flourished across the world fostered dance as a medium of religious expression and entertainment. It may be difficult to demarcate and identify explicitly, how dance evolved through ages across various cultures of the globe. Adherence to the present status of dance may reap good results to the present study instead of exploring the evolution of dance across various cultures, and to try to understand the intricacies of these dance forms in terms of constructing fitness issues of these dance forms.

Folk dances that existed in the human timeline have been mostly of social dancing than religious exploration. Some of the folk dances that exist in India are highly mature and affirmative in expression too. While most of the countries can boast of their folk and tribal dances in existence, India is very peculiar and conspicuous in the presence of folk and tribal dances. Every state in India can boast about the presence of several forms of folk and tribal dances. Bhangra dance of Punjab, Cheraw dance of Mizoram, Chhau dance of Odisha, west Bengal and Jharkhand areas are some of the very popular folk dances which require extra ordinary presence of skill and movement. Perini Shivatandavam is also a non-classical but very ancient dance form in Telangana

region. Most of these Indian folk dances are highly vibrant and physically demanding like Bhangra dance of Punjab.

When it comes to world scenario, there are several folk dances. Some important and mostly patronized dances are Irish step dance, Salsa an afro-Cuban dance, Tap dance which was originated in United States in 19th century, Break dance which was developed by African American youth in United States of America, Ballet of Russian origin, Lion dance which was originated in China. Most of these dances are highly energetic and physically demanding. Break dance which is still very popular among American and European youth is very dangerous to the human physical body, which might cause severe and sometimes highly debilitating injuries. Most of these dances are performed by youth and elderly and aged cannot perform. Serious and hard training is a pre requisite for performing these dances, as it is difficult to execute these complex and difficult physical moves of these difficult dances.

Another passion in dance which is happening at present dance scenarios is development of new dance styles with fusion of more than one individual dance forms of different regions. While this is one trend happening in the global dance scenario, another very significant and stunning change in Indian dance scenario is Modern Indian dance scenario. There are lot of experiments happening in the Indian dance scenario and this is leading to a new genre of dancers in India. In fact, some of the well trained and very well asserted classical dancers are developing new trends in Indian classical dances leading to new styles of dancing leading to Indian contemporary dance

styles. Padmini Chettur, Chandaralekha, Rima kallingal, Anita Ratnam are some of the important Contemporary Indian dancers with formal and authentic training in Classical Indian dances. Since, these contemporary Indian dancers prefer to include the elements of the classical dances and improvise into different movement patterns to make their dances more fluid, message oriented with necessary rasa to be carried to both the dancer and to the spectator. There is another trend taking place simultaneously in Indian contemporary dance. New genre of dancers have come up with very dynamic dance styles taking cues from modern dance styles. These styles are comprised mostly of freestyle movements with grace and flow and movements are not necessarily adhering to any classical Indian dance style components. The dance movements and gestures in these dances are mostly the brainchildren of the respective dancer, the elements of classical dances are disappearing or rather completely absent. These dance styles are using several other dance styles like ballet, salsa and even folk dances. However successful they are at the commercial level, these dances may not fit into one particular style or form. Slowly commercial success is aspired by dancers of these genre and making the dances more alluring to the spectators. Those multicolored gorgeous classical attires are slowly being replaced by different attires leading to the criticism, that the attires of such dances are seductive. However, the tenacity of the Indian classical dances like Bharatanatyam, Kuchipudi, Kathak, Manipuri etc. has never faded in the context of dance scenario of India, with severe competition from the contemporary dances of India.

Bollywood dance/Popular dance – a globally recognized dance phenomenon:

One significant and striking development in the scenario of Indian dancing is Bollywood dance/Popular dance. Increased global migrations caused for the exchange of cultural aspects across various nations including the dance culture. Several other dance forms like salsa, jumba etc. were introduced into Indian subcontinent because of this migratory interaction. It is also true, that the Indian classical dances were extremely disseminated in western audiences through the efforts of many Indian migrant dancers.

Globalization has made the Indians to settle in many parts of the world and it is estimated that around sixty thousand Indians are migrating to United States of America annually and several thousand Indians are settling in several European cities and these Indians are the torchbearers for the spreading of Indian culture, specially the Indian style of entertainment forms. Unequivocally, cinema can be considered as one powerful medium of influencing people. It is also a powerful medium through which the cultural aspects of a particular culture may be carried to other places of the world.

In the same manner, the medium of cinema may influence strongly on the perspective of audiences with respect to dance and music etc. In fact, medium of cinema helped to make familiarize with Indian classical dances with masses of India and caused for the spread of Indian classical dances and their image across the country. As a medium of entertainment, cinema tried to portray the classical dances more appeasing and assuaging to satisfy the emotional happiness of the audiences, as this is

linked to the commercial success of cinema. This might be the reason for making the cinema choreographers and actors preferred more accelerated dance styles and modified classical dance sequences came into existence of cinema. Though the major share of the Indian cinemas originates from Bollywood, there are others which also contribute for Indian cinema like Tollywood, Kollywood etc.

Faster and appeasing dance sequences started appearing in 1960s and slowly the rhythm and style of Bollywood dance or Indian cinematic dance attuned to the tastes and responses of the cinema spectators and since then the Bollywood dance is constantly transforming by incorporating several bits of other popular dance styles, Indian classical dances and other forms of folk dances. Intense competition among the Bollywood dance choreographers made them to come with more and more fluid and stimulating dance sequences for gaining commercial success. Many a time Bollywood cinemas became commercially successful just with the presence of extraordinary pieces of song and dance sequences in the movie. These films simply portrayed the song and dance sequences just to suit the taste of general masses to gain commercial success and popularity.

The Bollywood dance sequences are so attractive, that it is little or no exaggeration about the immense effect on the global spectators too. Some of the Indian cinematic dances were highly successful in United States of America and some of the European countries. Slowly the Bollywood dance has become very entertaining and highly acceptable among the global spectators and this impact caused for the start of

several Bollywood dance studios in United States and European countries. These dance studios are very famous and commercially successful too. Western clientele throng to these studios for learning Bollywood dances for emotional gratification and for gaining physical fitness.

The signature effect of Bollywood dances has been wide and deep with peculiar style of dance that attracts the human emotional domain. The signature movements in Bollywood dance need complex motor skills, excellent neuro muscular coordination and fantastic anticipation. Still the antiquity of Indian classical dances lingers on with Bollywood dance sequences and in fact they are still major chunk of the dance sequences. Integration of physical movement and emotional expression through facial manifestations that would suit to the situation is an essential ingredient of the Bollywood dance sequences and this dance element would definitely be considered as the primary and dominant aspect of these dances. Grace, poise and rhythm are three important elements of this Bollywood dance sequences, wherein the part played by the music accompanying the dance cannot be undermined. In fact, music is another vital part of the Bollywood cinema, which entertains the audience with unparalleled excitement and thrill. It may be difficult to separate music from the dance sequences of this cinema, but Bollywood dance is something which is becoming a global phenomenon because of its keen entertaining value. These dance sequences made some of the Bollywood movies become blockbuster hits at the United States and some of the European countries too. A frenzy craze prevails across the globe for this

Bollywood dances because of their electrifying, expressive and highly exciting dance moves.

While the Bollywood dance, which is a representative dance style of Indian cinema industry is a worldwide happening phenomenon and is widely accredited as an enigmatic dance style, inside India it is a fervor among young and adults alike. There have been several fitness studios which teach this Bollywood style dance sequences for fitness purposes.

Dance and relevance of fitness to dance and vice versa:

Dance may be explained as a physical manifestation through movement of body and its segments in a rhythmic manner with appropriate emotional expression. This may be taken as an acceptable meaning for the definition of dance by classical dancers.? Rhetorically speaking, dance must have two important elements in it, the first being the rhythmic physical movements of the body and bodily segments and the second one being the emotional expression which suits to the meaning of the song that may be accompanied with the dance. Dance in isolation is very rare than in combination with a song sequence or with some folk or social issue.

Unequivocally, dance is a physical movement and certainly requires certain level of physical fitness. This can be very easily seen and deduced from the comparison of dances performed by youngsters and aged individuals. Whether it be classical dances or some modern/ contemporary dances, fitness is highly essential to perform at a higher physical intensity and to gain and maintain perfect higher order posture and

gait of dance (***Rodrigues-krause J, Krause M et.al 2015)***. Also an old person cannot perform a dance sequence at the same higher order physical intensity, as like when the same person used to perform when the person was quite young. This is all because of aging and the effect of aging. The effect of aging is very palpable on the aspects of physical fitness and its components.

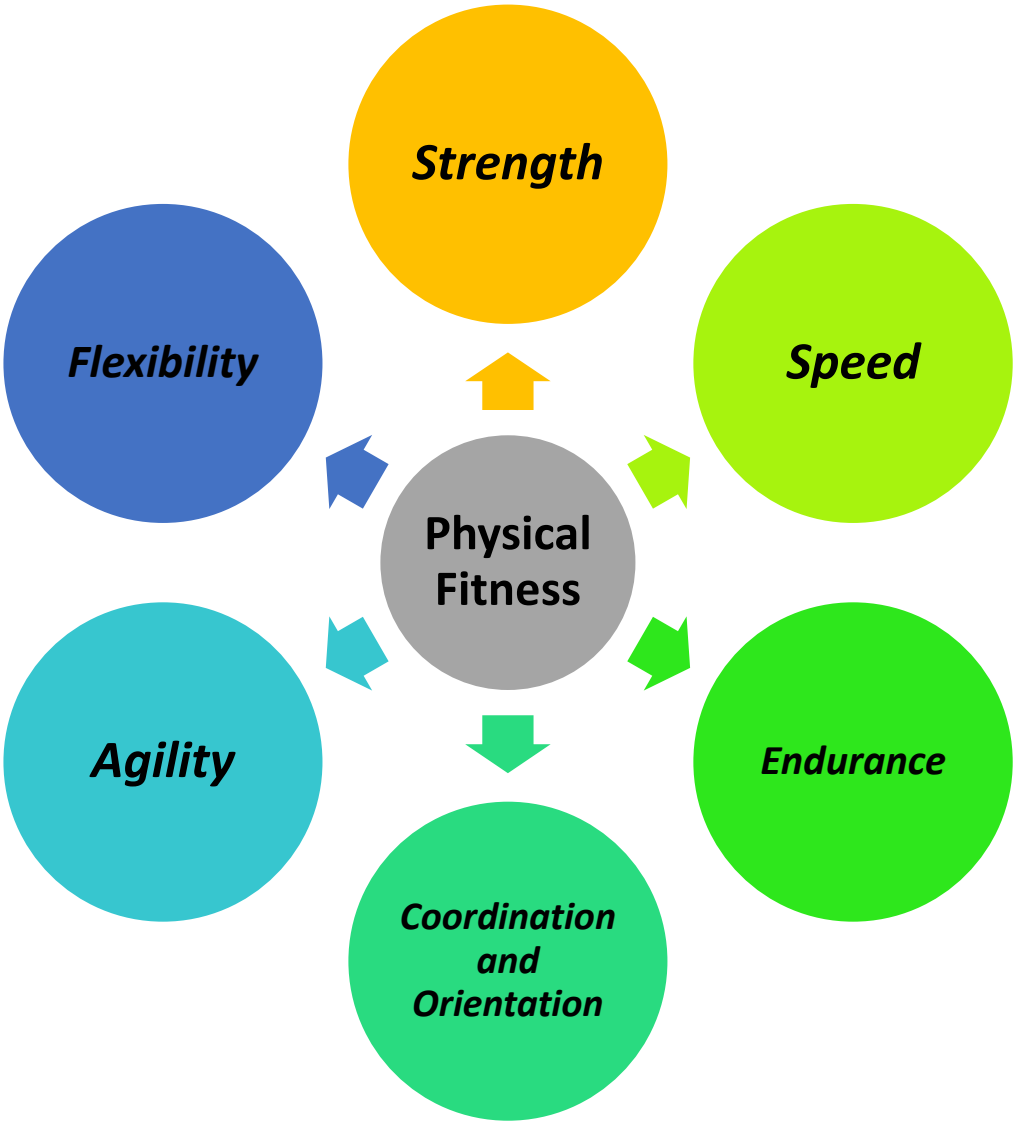
For execution of physical movements like dance movements and other sporting movements, individuals need physical fitness. It is also a fact that there will be a marked and palpable difference in terms of physical intensity of dance when a same person performs some dance sequence during different ages of one's life time. The same may be ascribed to the diminished physical fitness which is a prime and essential physical ingredient for dance performances. This may be an analogy, but the fitness science clearly indicates about the effect of aging and also the difference in fitness levels depending on the physical activity undertaken as a training process on scientific lines.

For any physical movement execution, there are several additive components are highly essential and they are interrelated and needs to be developed on scientific manner. Physical movement like a dance sequence may be external for observation, but the essential aspects of these physical movements may arise very internally and may be associated to mental and emotional aspects of individuals.

Physical fitness and components of physical fitness:

Physical fitness may be understood as the ability of an individual to be able to meet the physical demands of a physical task without any undue fatigue. Though this may be termed as a generic view on the term physical fitness, but a vivid examination is henceforth an important issue. In more specific and scientific perspective, physical fitness needs to be recognized in terms of a specific physical activity done by individual. The science of sports training had recognized different components for physical fitness and they are the contributing physical ability components for doing different types of tasks for different durations and at different intensities. These components are related to meeting the physical demands of doing different physical tasks whether they be daily routine works or participation in sports and games activities. In fact, sports science explained these components in view of the sports activities. However, it may not be difficult to attribute these components to the daily activities of individuals including to dance.

It is necessary to understand these individual components to be able to correctly perceive about the true nature of physical fitness, since physical fitness is mixture of these individual components in different ratios depending on the physical task that needs to be executed. Hence, an individual requires these individual components in some quantity or other, while some may be essential in higher proportion while other may be needed to some extent.



Strength: "Strength is an ability of an individual of overcoming resistance, the resistance may be of one's own body or an external physical object".

Lifting weights for exercise, lifting a bucketful of water etc. may be considered as the resultant quality of strength. Even getting up after squatting, sitting and standing, mounting of steps may also be considered as the result of the ability of strength. Generally, the strength is ascribed to the skeletal muscles and their

contractions. All the above physical works are the resultant actions of skeletal muscle contractions. The ability of strength may be comparative. When a person is able to lift bigger weight than another individual, the first individual may be considered as having more strength when compared to the second individual. In the same way, if an individual is able to lift more weights than previously due to constant practice of lifting weights, the individual may be said to have improved the strength. It is necessary to realize that this quality of strength of an individual also depends mostly on the quality of skeletal muscles of an individual. An individual with more of glycolytic muscle fibers in their skeletal muscles may be predisposed with better strength ability. But, this element of strength can be developed and maintained through constant and scientific training by every individual, irrespective of genetic predisposition, except the genetically predisposed persons are able to derive higher order benefits through training and be stronger.

Speed: "Speed is an ability of an individual of doing a physical task/motor activity repeatedly at a very quick succession".

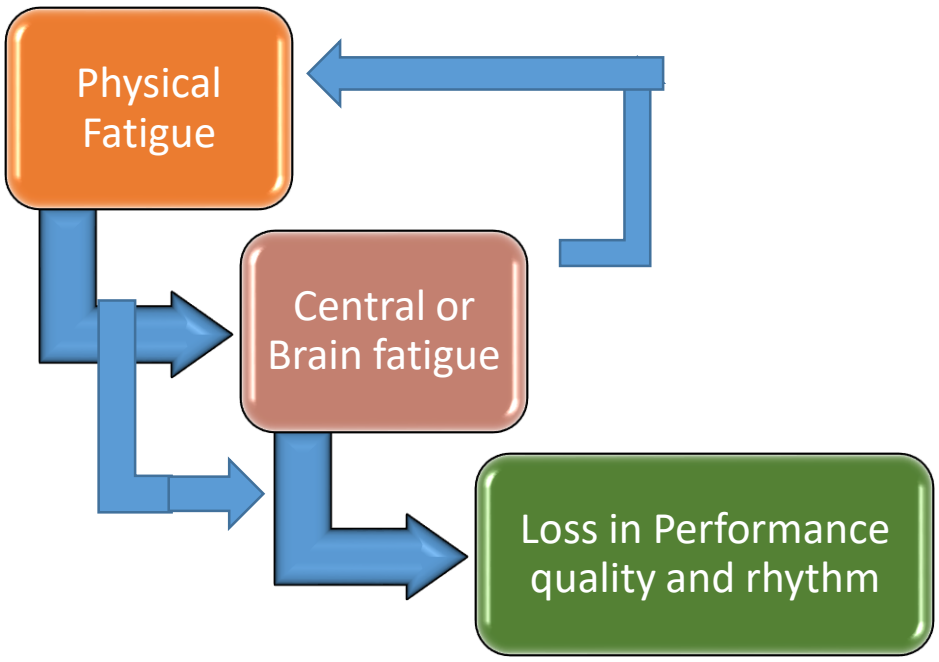
In several sports situations, the individuals need to execute the physical actions at a very quick succession to be able to dominate the proceedings of play or sport. In several motor actions that are executed during the daily routine, also need to be done at some speed in certain instances. Sports science clearly endorses the view that the individuals are pre disposed with the quality of speed, which can be ascribed to their skeletal muscle quality and their neuromuscular facilitation level, which is again

derived through the inherited genetics. Quality of motor neurons, the quality and the intensity of the neurotransmitters and their transfusion at the neuronal junctions, reactions at the neuromuscular junction are all responsible for the efficient and faster motor actions of an individual. Some individuals are richly endowed with these biological qualities and can enjoy faster motor activities when compared to others. This is the reason, why some individuals' actions are faster and some individuals' physical actions are slower. The variations in the motor activity speed may be ascribed to the above biological phenomena.

Endurance: "Endurance is an ability of an individual of executing the motor actions/physical tasks repeatedly for longer time without getting undue fatigue".

This component of the physical fitness makes individuals to sustain physical activities for longer and longer duration. Walking for long distances, trekking mountain terrains, running for longer times, dancing for long durations are examples of physical tasks that are possible through the capacity of endurance. Higher this component of physical fitness, individuals can sustain motor or physical actions for longer time. Even immoderate levels of fatigue may make individuals to falter at their physical rhythm and their neuro muscular coupling process leading to loss of quality in physical task and poor execution of physical or motor task. There are two aspects associated with the fatigue and they are physical fatigue and mental fatigue. Mental fatigue sets in an individual, when the individual conducts mental work for longer duration. Physical fatigue is normally considered as the result of accumulated toxic

metabolic substances in various tissues like muscle, liver and brain causing the physical movement sluggish or difficult to continue. A very interesting phenomenon is the physical fatigue normally accompanies with mental fatigue also. May be due to the accumulation of inordinate amounts of neuro transmitters in neuronal junctions or due to accumulation of toxic metabolic substances like lactate etc. causing the brain function, especially the motor cortex function more sluggish and degraded. Other possible interactions in motor neuron firing quality are reduced electric stimulus carried through the neuronal junction and into the muscle leading to reduced muscle contraction force. This reduced muscle contraction force causes for the reduced strength and reduced quality in physical activity and motor task. Another imminent danger in this central fatigue conditions that would arise is about the reduced efficiency of the central pattern generators (CPGs) of nervous system which would cause for the reduced coordination of the neuro muscular functions leading to disintegrated or awkward physical movements.



Hence, the interrelationship among the endurance, strength, speed is highly intricate to understand. Reduced endurance can show impact on the strength, speed and even the agility components of the fitness of an individual leading to reduced strength, reduced speed and reduced agility levels.

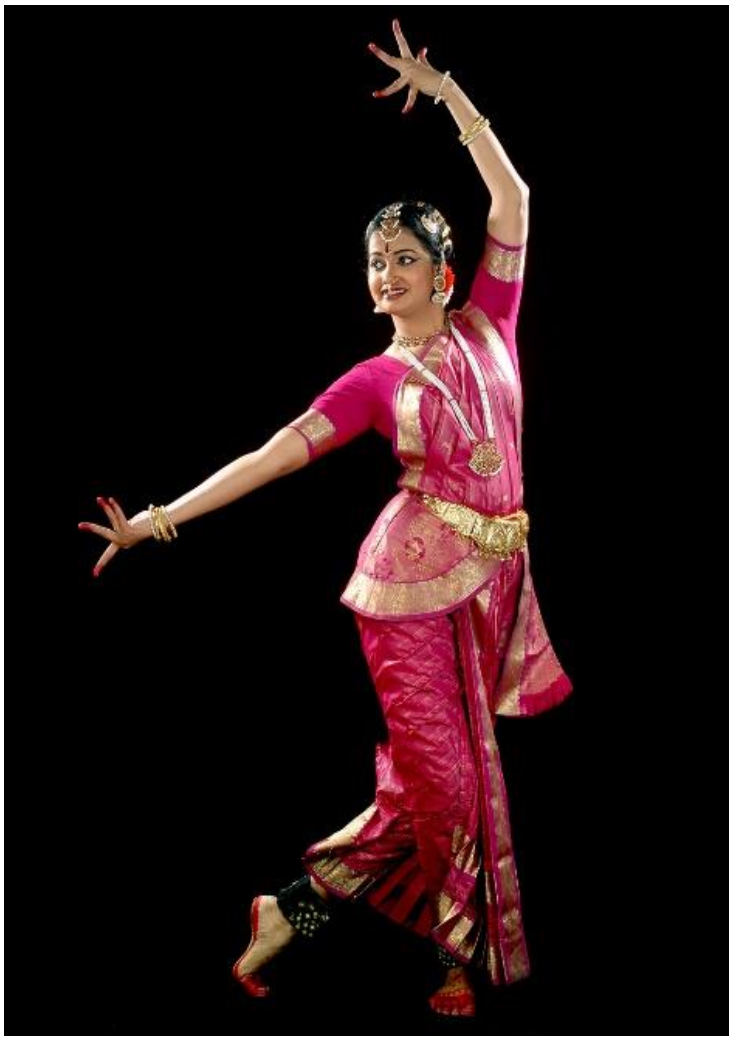
Agility: "Agility is the ability of an individual of changing the body and different segments of the body at will from one direction to another direction and at immediate instant".

This is very important physical fitness component which is highly essential for a dancer to perform very intricate and complex dance movements with significant grace. This ability decides how quickly an individual can change the movement pattern from one direction to another direction by changing the whole body or some segments of the body. For sports participation and for excellence in sports, this ability is highly helpful and hence proper training for this ability is necessary. The mechanism of agility is both conscious and unconscious. Since, the agility also comprises of the velocity of change of direction, this component also linked to the speed ability of the individual. This complex physical fitness component needs to be examined in many perspectives. This ability depends on the individual's visual processing, reaction ability, perception, anticipation etc. Sudden change of direction of body or some segments of the body require both physical and cognitive abilities. Muscle quality and type, neuro muscular connections and their qualitative reflexes are recognized as the physical qualities related to agility, while perception, processing at the higher centers of brain like cerebellum and anticipation are some of the inherent cognitive essentials for agility. Many a time conscious visual processing is also an essential ingredient for higher order agility. There are several physiological mechanisms that take care of this physical fitness component and hence mostly this ability is genetically determined though chances are there for improving this ability through scientific physical training.

Coordination and Orientation: "Coordination and orientation ability may be understood as the ability of an individual to finely integrate the different segments of

*the body as per the physical task requirement and to keep the body and its segments oriented to the earth in proper direction and balance" (**Ridderinkhof KR and Brass M 2015**).*

This physical fitness component is another very important component for execution of complex and intricate motor tasks or physical movements like dancing, playing dynamic games like shuttle badminton, participation in gymnastic tasks etc. Poise, fluidness and grace while executing complex physical tasks like dancing requires high levels of coordinative and orientation ability.



Sports sciences attribute this ability to the level of Proprioceptive Neuromuscular Footnote Facilitation (PNF) of an individual. This particular bio-mechanism is a complex phenomenon that necessitates immense explanation. This particular complex phenomenon is regulated by several dozens of

proprioceptors that exist in different areas of the body, especially in joints and muscles of the individual. Coordination and orientation is mostly about how an individual can integrate the different limbs of the body and place the whole body oriented to earth in

the desired direction and angle and to produce meaningful, graceful and highly fluidic physical movement patterns that are necessary for the event the individual is participating in. The Indian classical dances like Bharatanatyam, Kuchipudi require this ability in very high and matured levels for graceful and aesthetic performances. The abilities like hand eye coordination, leg eye coordination, hand leg coordination, hand torso coordination, torso leg coordination, left and right coordination, left and left coordination, right and right coordination, dynamic balance are considered as sub components of Coordination and orientation ability. Proprioceptors that exist in joints

and muscles constantly perceive the movement signals through the muscle contraction forces and other friction forces and convey to the higher order brain processing centers like Motor cortex, cerebellum, basal ganglia etc. and the modified stimuli are received for making necessary corrections in the movements of limbs during the execution of these movements. Muscle spindles that exists in the muscle belly, Golgi tendon organs which exist in the tendon part of the muscle, Pacinian corpuscles that exist in the joint capsules are some of the examples of proprioceptors that perceive the movement patterns of the limbs and relay the same to the higher order processing centers of brain. Interestingly, the sports science clearly concluded that the ability of proprioception needs to be matured before the puberty of an individual. Proper training should be taken place to ensure that the proprioceptors are matured before the thirteen or fourteen years of an individual to attain the maximum proprioceptive ability. Highly matured proprioception ability is the necessary ingredient for excellent levels of coordination and orientation ability of an individual. Hence, the training need to be provided to children of growing age, from seven to eight years onwards to make the proprioceptors to get responded and matured properly.

Flexibility: "Flexibility is an ability of an individual to be able to produce greater range of movement at the joints".

This is another very important physical fitness component or factor that enhances the physical performance during motor tasks like sports movements or dance movements. Higher the flexibility, an individual can move the joint more easily through

full range of motion to execute the physical movement unhindered. Variations in the ability of flexibility may arise among individuals due to difference in the muscle quality, tendon make up and other joint apparatuses like the ligament structure and ligament biological make up apart from the regular practice. The flexibility levels may be highly influenced by regular flexibility training, which include the exercises that enhances the elasticity of the muscles, elasticity and restitution of tendons of the muscles surrounding the joint and also the elasticity and restitution levels of the ligaments that surround the particular joint. The temperature of the muscle tissue and the tissue that surrounds the joint also has impact on the elasticity of the muscle apparatus and cause for increase in the elasticity and flexibility of the joint. Hence, a proper warming up session before any physical activity like sports or dances would keep the muscular and ligament tissue ready for the activity with increased range of motion. With better flexibility, the undue stress on the movement of the body can be reduced significantly and can produce more graceful movements with ease and comfort. Injury prevention is another advantage of better flexibility and better range of motion. Though genetics can also be attributed for comparatively better range of motion among some individuals due to the relative elasticity in the ligaments with proper strength, the flexibility is highly trainable.

Interrelationship of physical fitness components and effect of this interrelationship on the dance performances:

Higher the physical fitness the better will be the physical performance and hence these two are directly related and also interrelated too. Physical fitness can be improved through participation in physical activities and by increased physical fitness, participation in physical activities becomes easier and comfortable. In an analogy that the higher physical fitness makes individuals to participate in sports and physical activities with more comfort, the same is true with participation in dance activity. Increased physical fitness can make a dancer to perform with ease and sustainability. The dance performances last for few minutes continuously without break, it would be ideal to have good physical fitness for the dancer to perform without getting undue fatigue and also to secure the dance movements of their grace and perfect coordinative rhythm. More vivid discussion on how different components of fitness are necessary for dance performance will bring out the importance of these factors in terms of excellent dance performance.

Strength helps a dancer to sit and stand at a quicker pace or at a comfortable manner. Strength is also essential for a dancer to execute squatting, lunging movements with more comfort and ease. In actual terms this factor of fitness need to be called as ***Power*** instead of strength. Strength is a raw component of fitness, which denotes only the ability to overcome resistance without any reference to the time taken for overcoming the resistance. It is very necessary that a dancer should be able to

overcome the body resistance in different postures at a very quicker pace than slower pace and for this the dancer requires dynamic strength which is also called as power. Power is the ability to overcome resistance in relation to time or overcoming resistance with quick pace. Power is explosive in nature and most of the dance movements are explosive in nature. Sports scientists generally believe that basic strength need to be improved before the same may be converted to power or explosive strength, but in fact the same may not be correct in strict sense. Certain strength training protocols which will in fact boost the power aspect of individuals need not prerequisite with higher amounts of basic strength, but the training in this end must be very scientific. There are certain forms of exercises which can promote the power component of the individual, like plyometric exercises are injury prone and need to be practiced with proper precaution and care. Raising legs at maximum range of motion also

require appropriate quantities of power accompanied with the reasonable level of flexibility (***Valenti EE, Valenti VE, Ferreira C et.al. 2011***). Exercise physiologists also indicate that those persons with high percentage of fast twitch muscle fibers/glycolytic muscle fibers may be able to show better strength and power than those with slow twitch muscle fibers/oxidative muscle fibers in their skeletal muscles. There may be a slight compromise in terms of sustained endurance during the dance activities by those with higher proportion of fast twitch fibers due to quicker toxic accumulation in muscles.

Strength and power should be developed in the related muscles which are responsible for the particular movement. Prime movers/agonists and anti-agonists,

synergists and fixator muscles of every dance movement needs to be studied and appropriately strengthened. This particular subject area is dealt in Exercise Kinesiology or Dance Kinesiology. This is very important study area for dance specialists to make their dance movements easier, flowing and graceful to produce rasa among the spectators and to the dancer himself too. Study on Dance kinesiology makes the dancer to understand the group of muscles that are responsible for the primary movement and also other support muscles and thereby offers a chance for the dancer to work out on those muscles and develop appropriate strength and flexibility (***Januara M, Tepla L, Strakova P, 2018***). Apart from working on the strength and flexibility of those muscles which are responsible for several movements of the dance, a dancer must also understand that certain specific areas of muscles which are very important in maintaining the overall posture of the body like spinal, upper back, abdominal muscles (core muscles of the body) need to be worked out for developing appropriate strength, power and flexibility. This provides excellent stability for the dancer during the dynamic dance performances and makes the dancer very comfortable with rhythm to maintain.

Speed component of physical fitness is essential for the dancer to produce faster rhythmic movements in succession and to make the dance more and faster and graceful. Some dance forms like Bhangra (popular fork dance of Punjab in India), Tap dance (a very dynamic and percussive form of dance, took origins from different dance forms of Africa and America and got popularized in United states of America), Salsa dance (originated in Caribbean) are highly dynamic and require the speed component

in very high proportions. Even the Thillana one of the items in the repertoire of the South Indian classical dance forms is faster in rhythm and requires higher speed quality for a dancer to perform very comfortably without undue speed fatigue. As per the exercise science/sports science, a predisposed advantage prevails for those who are born with fast twitch muscle fibers/glycolytic muscle fibers in their skeletal muscles. But, there are certain specific speed drills which can promote speed in the body to produce faster dance movements. Power is another fitness component which can directly influence the intensity of speed performance. Increase in power of the muscles lead to the increase in the speed of the muscles and their contractions. Higher neural plasticity makes the person more sensitive in terms of neuro muscular facilitation and excitation of the muscle and consequent contraction (***Niemann C, Godde B et.al. 2016***). Quality of myelinated neurons, neuromuscular end plate, neuromuscular junction threshold to neuro transmitters, type and quality of neurotransmitters etc. may show significant impact on the electric excitation of the muscle and consequent muscular firing and contraction (***Blashing B, Calvo Merino B, Cross ES et.al. 2012***). Hence, it is highly essential for a dancer or a dance teacher to understand the interrelated issues of fitness components and accordingly the training should be planned.

Coordination and orientation ability of an individual plays very significant role in the performance of dance. Coordination includes coupling of limbs of the body and coordinating different limbs of the body as per the requisite form of dance and this is a complex ongoing process in the nervous system during the dancing activity and is

influenced by the proprioception mechanism of the individual (***Kattenstroth JC, Kalisch T et.al. 2013 and Sumanapala DK, Walbring J et.al. 2018***). With constant practice the proprioception abilities may become automatic leading to comfortable coordination of various limbs and torso of the body for producing finest movements during the dance. Indian classical dances like Kuchipudi, Kathak, Bharatanatyam, and Odissi comprise several complex movements that require the dancer to coordinate the legs and hands in a very precise manner to produce highly electrifying movements. Gyrations in Kathak dance form is an example for the individual's orientation ability (***Golomer EM,Gravenhorst RM et.al. 2009***). Balancing of centrifugal and centripetal forces through excellent orientation ability which include the balance ability is the hall mark of this Kathak dance form. Some of the western dances like hip hop are highly dynamic and need extraordinary levels of this fitness component. Even the modern contemporary Indian and western dancers are trying to incorporate highly dynamic and physically very difficult to execute movements in their dance sequences. Hand eye coordination and leg eye coordination movements in Indian classical dances like Bhratanatyam and Kuchipudi are highly unfathomable. In dances like Bharatanatyam and Kuchipudi, some of the moves are very intricate and highly sensitive in terms of coupling ability, wherein even the fingers are used to develop mudras and for expression to coincide with the emotional expression of the dancer. This requires exceptional neuromuscular coordination in the dancer. The phenomenon of "Reciprocal Innervation" plays vital role in terms of muscular contraction and the higher ability of this phenomenon makes the muscular contractions and relaxations

more coordinative and perfect. Reciprocal innervation indicates that the neural connections are very intricately connected to both the agonist and anti-agonist muscles to respond in a sequential order. For example, when a person folds the hand at the elbow, the biceps of the upper arm contract to produce the movement. But the

movement will only happen, when the opposite muscle group i.e. Triceps relax proportionately and at the same intensity the biceps are contracting. Hence, both contraction of agonist and the relaxation of anti-agonist are essential to produce a movement at a particular joint. The neuronal connections are very appropriately connected to complete these two actions simultaneously and the neuronal plasticity as earlier explained is highly essential for smooth muscular contraction. Apart from the

PNF (Proprioceptive Neuromuscular Facilitation) CNS (Central Nervous System)
CPG (Central Pattern Generators at Spine)

concept of smooth muscular contraction, another essential ingredient for coordination and orientation ability is the phenomenon of proprioception (***Kiefer AW, Riley MA, Shocklay K et.al. 2013 and Filqueiras A, Quintas conde EF et.al. 2018***). The neurobiology of the rhythmic movements and coordinative physical/motor acts indicate that the Central Pattern Generators (CPGs) that exist in the lower thoracic and lumbar regions of spinal cord and would coordinate with the higher order brain centers to generate the reflexive rhythms to produce excellent coordinative physical movements and postural stability (***Zhang JG, Ishikawa-Takata K et.al. 2008***).

Agility is another very important fitness component that can enhance the fluid and grace in the dance movements. Unlike the sports situations wherein there would be several occasions a sportsman should encounter with sudden offensive moves for counter reactions to be done. These are the circumstances where the sportsman would need to react very spontaneously and change the direction of the body or limbs of the body as per the required situation. But in dance sequences, the dancer need not react to the spontaneous situation, but need to change the direction of the body or limbs of the body as per the required dance sequence which is premeditated. However, the ability to move body and body segments at will to the required direction is certainly will foster for better dance performances and would lead for flow in the dance sequence. Since, agility depends on the biological factors like proprioceptive

mechanism, type of skeletal muscle tissue, neuro facilitation and neuronal transmission ability, the factor of agility may be trainable only to limited extent (***Olshansky MP, Bar RJ et.al. 2015***). Early training for agility would bring some encouraging results and hence dancers should concentrate on this ability at a very tender age and try to consolidate the quality of agility.

Endurance, an ability to make individual to physically work for longer time without developing undue fatigue is also an essential physical fitness component for dancers to sustain the dance movements during the later stage of their dance performances. In sports science, endurance is synonymously used for Cardio respiratory endurance, since cardiovascular and respiratory systems are mainly responsible for the endurance capacity. Endurance capacity of an individual is linked to the efficient energy production at the skeletal tissue level and to sustain the physical activity for longer time. Generally, the endurance capacity is measured through a phenomenon called VO2 max or maximum oxygen consumed during a physical activity per kg body weight per minute. Local muscular endurance also is essential for higher sustainability during the physical or motor tasks like sports and dancing. Improved angiogenesis causes for the better vascular network for better supply of blood and nutrients at the tissue level i.e. at the local muscle level. Generally, the local muscular endurance and the general Cardio-respiratory endurance are mutually dependent (***Josianne Rodrigues-Krause, Juliano Buufleur Farinha et.al. 2016***). Higher usage of oxygen is identified as better beta oxidation and better energy production through the utilization of fatty acids and sustainability of physical activity

without fatigue. Dancers require good amount of cardio respiratory endurance to sustain their complex dance movements for longer time without losing the gait, posture and flow of the dance. Generally, when the dance performance goes into an extended period like ten to fifteen minutes at a stretch, it may be difficult for the dancer to execute the dance movements at the same vigor and intensity and may lose the expression quality also. Some of the classical Indian dances like Kuchipudi etc. are very expressive in execution, it would be ideal to have higher level of endurance to keep the pace of the movements and also the emotional ability to make highly expressive movements. Setting in of fatigue leads to the decreased intensity in performance and also in emotional expression. Physical fatigue is responsible for loss of intensity in physical movement due to toxic build up in muscles leading to aberrations in muscular contractions. Other possibility is setting in of mental and emotional fatigue while performing. Central or mental fatigue not only affects the cardiorespiratory endurance but also negatively influences the speed, strength, coordination and orientation abilities. The fatigue of Central Nervous System need to be taken care of properly by a dancer, as it may affect the length of the performance and quality of the performance too. Practice of physical activities or dance for sufficiently extended periods would improve this ability of endurance. Special physical training at higher intensities for longer periods may also help a lot to the dancer in maintaining ease at the time of performing dance for extended periods of time.

Flexibility helps a dancer to move the limbs of the body through full range of motion very comfortably and this is an essential ingredient of fine and dexterous movements. More elastic muscles have higher proprioception ability and would contribute for the graceful movements during dance. Interrelationship between the strength, speed and flexibility cannot be undermined. Higher strength and speed qualities are highly required for better flexibility, specially the dynamic flexibility shown during the dance movements and also during sports movements. Most of the dance movements

are dynamic in nature and extension and moving various limbs of the body through their range of motion requires lot of power among the muscles groups concerned which are responsible for the movement. The aspect of reciprocal innervation olds very valid for the dynamic flexibility, as the primary movers or agonists contract for producing movement making the limb to move away from the joint, anti-agonist muscles should respond with their elastic nature with proper accommodation to the agonist movement (***Simonsen EB 2014***).

Hence, the interrelationship among the various physical fitness components is highly intricate and interdependent. A specialized study is highly essential to understand these intricacies and to train a dancer appropriately for deriving the

expected results in dance performance. Physical fitness is not a generic concept not to just interpret in simple terms, but a very complex phenomenon to be explored. Certainly special physical fitness training basing on the sports science principles leads to better performances among dancers of any form and style. Moreover, some of the western dances and also some of the Indian contemporary dance styles are highly dynamic and require high amounts of physical fitness. But, it is essential to understand that different physical fitness components may be required in different proportions for different dance styles or forms and accordingly dancers should get the appropriate training. This needs the help from the sports kinesiologists or dance kinesiologists and exercise physiologists etc. In some of the western and American dance departments, the curriculum also includes the study about the Dance Kinesiology, Dance Biomechanics, Dance Psychology, Dance Physiology etc.

It would be ideal and scientific to study and to know about these subjects and their contents by a dancer for a better and more authentic dance performances, whether it be Indian classical dances, Indian folk dances, Indian contemporary dances or any western dance.

Evolution of fitness culture and use of dance as a medium for fitness:

Health and vivacious lifestyle has been a long cherished and practiced concept for human beings and this is seen since time immemorial. Very high importance has been attached to wellness and beautiful body even in the ancient civilisations. They are very evident through the preserved paintings and sculptures of ancient civilisations.

This is very specific to the great Indian civilization and to the Ancient Greece civilisations where in beautiful and aesthetic bodies with full blown health were given highest respect.

Passion for fitness especially physical fitness has been there since ages in the human culture. Even oldest human civilisations attached so much importance to physical culture where physical fitness is one of the top priorities. Lack of sophisticated weaponry made it compulsory to depend on physical strength of a soldier in ancient days. Ancient civilisations like Sumerian, Egyptian, Pan Hellenic Spartan, Babylonian etc. all were after the strong armies and physical culture was very dominating. Especially the Spartans believed in a very strong soldier citizen and they did not even hesitate to terminate the life of a newly born child with physical disabilities. The elders of Sparta used to decide whether any new born child should be survived to make a strong soldier or not. Even in Indian mythology there are several great heroes who are known for their valor and physical strength. Several testimonials exist to attest the importance of physical fitness in ancient period up to the pre second world war. Industrial evolution in Britain necessitated for a better worker with physical fitness. Slowly the further scientific evolution caused for drastic changes in the lifestyles of modern human beings. Slowly the human being is bestowed with several household gadgets and other scientific instruments that helped human to be more comfortable in lifestyle. This probably made the modern humans becoming lethargic and dormant and finally physically inactive. Highly comfortable, luxurious and physically inactive lifestyles made human beings to be prone for several degenerative

diseases. Degenerative diseases like Diabetes Mellitus, Hypertension, Arthritis, Cancer, Obstructive Lung disease, certain Psychological disorders are growing worldwide and the percentage of deaths due to these communicable diseases are growing to phenomenal and alarming levels. For example, India has become the hub of Diabetes and India has highest Diabetics in the world than any other country.

Obesity has become another widespread problem across the globe and no country is an exception to this disorder. Even the childhood obesity in developing and developed countries has become a big worry and a big hurdle for further health development. Obesity disorder can bring several consequent health problems like renal failure, hypercholesterolemia, hypertension, immune suppression, respiratory disorders, joint disorders and even psychological disorders. Obesity has also a very strong link to the development of cancer. Obesity further precipitates to physical inactive lifestyle and this is a vicious cycle. As per one of the schools in genetics which proposed the "thrifty gene hypothesis" postulates that the human genome consists of genetic material with predisposition to obesity because of evolutionary changes for millions of years of food scarcity and sudden abundance of food which prompted the ancient humans to store fats in large volumes for survival. This postulation may need further verification, but it is a scientific fact that the abundance of food intake would make the individuals fatty and obese leading to several obesity related complications earlier mentioned (***Murphy EC, Carson L, et.al. 2009***).

There are many other factors that might have propelled for the evolution of fitness culture at present day life. Apart from the fear of disease and unhealthiness, people tend to exercise because of reasons like aesthetics, social relations development, inherent enjoyment and many more. One additional factor that needs mention is the increase in the disposable income of people. With increased disposable income, people tend to involve in activities which might give them happiness and relaxation from the routine lifestyle. Slowly this tendency lead to the fitness revolution and increase in fitness enthusiasts across the globe. There may be differences in perceptions of these fitness freaks in terms of healthfulness of the exercise, but still there is a common belief that exercise and physical activities will enhance the domain and attitude of the individuals leading to better quality life.

Dance is also considered as a physical activity in general. But the inherent derivative values of dance are myriad. Dance not only fosters the enhancement in physical functionality of the body through increased physical fitness but also serves as a powerful tool for the emotional satisfaction leading to control of emotional stress (***Mario Cerrano Guzman, Carmen M Valenza-penza et.al. 2016***). Several researches on physical activity, especially on the effect of dance on stress management revealed that dancing will cause for the release of the feel good hormones like beta endorphins in ample quantity and make individuals to feel emotionally happy and elated. Specially, noncompetitive dancing done in the dance fitness studios would foster for this condition more effectively. People enjoy the environment of dance thoroughly as there are neither restrictions nor awards (***Iris Brauninger 2012***). Noncompetitive

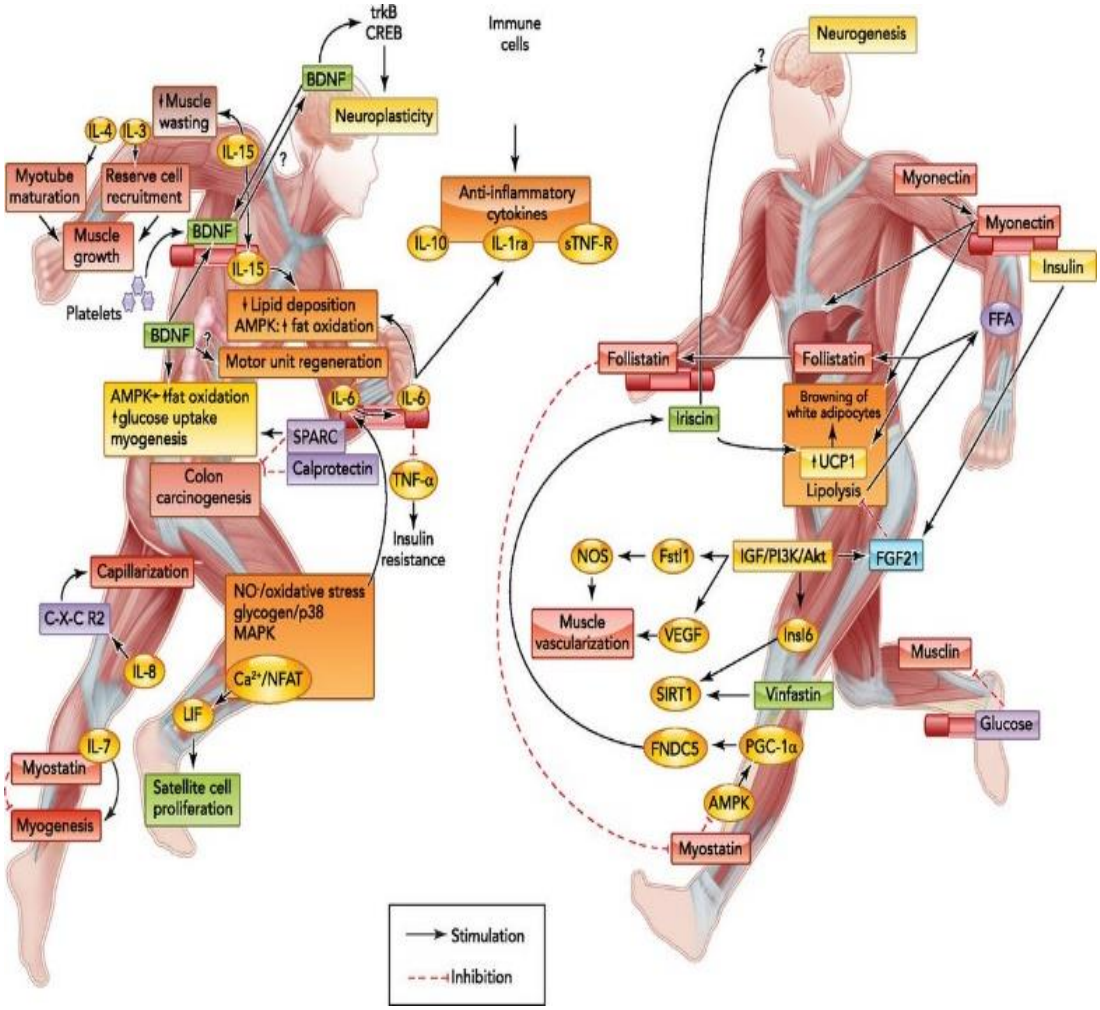
dancing has become a revolution in fitness industry with several fusion forms of dances with their associated dance studios.

Why should we exercise or physically be active?

This is very important postulate which needs to be understood in proper stance and authority. It is very generic that exercise improves fitness, may be both physical and mental fitness of an individual leading to better health condition. But, exploration in this regard is essential to make people to realise the importance of physically active lifestyle and especially regular high intensity exercise routine.

Evolutionary process and the adaptations occurred to human beings for all these millennia need to be understood carefully. Scientists of population genetics are also in support of the view that the genetics of the present human being is not much different when compared to the human beings of two lakh years ago. Since time immemorial the human beings have been very active physically for the sake of survival and existence. Humans used to be as hunter gatherers for several thousands of years and the same went up to around some ten to fifteen thousand years ago, when the human beings started settling down as agrarian cultures. The ancient humans used to run after the animals to hunt for food and also used to run away to escape from the wild animals. The biological adaptations are so evident that physical activity is highly essential activity for the regulation of all metabolic processes of the human body. The link between the physical activity and disease prevention capacity has been clearly established recently by exercise endocrinologists.

Exercise endocrinologists identified that during physical stress the muscles are seen producing hormone like chemical substances, which they called as myokines. During the muscular contraction, the myokines are produced and are put to circulation to reach to the target tissues of the body and perform various biological activities. FGF 21 myokine promotes the uptake of glucose by stimulating insulin, NOS factor is another myokine which induces for the arterial elasticity leading to stability in blood pressure. These are certain examples which are muscle derived biochemical responsible for prevention of certain diseases. Muscular stress of contraction is



essential for the release of these chemical substances and a consequence of the genetic adaptation for the humans. There are many dozens of myokines that are released during the muscular contraction are responsible for prevention of several degenerative diseases. Hence, muscular contraction at an appropriate intensity is highly essential for the healthy survival of human beings. It is not simple muscular contraction, but the physical activity should be of at a threshold intensity to derive myokine secretion in the muscle.

The physical exercise makes individual more immune to several degenerative diseases and also resistant to several communicable diseases also by enhancing the immune function and by enhancing the biological function levels of all the systems of the human body. Physical exercise can also enhance the mental and psychological functions of the human beings by enhancing the neuronal plasticity through the myokine called BDNF (Brain Derived Neurotrophic Factor), which enhances the neurogenesis (formation and development of neurons of the nervous system, especially the central nervous system). Moreover, the euphoric effect of the physical exercise brings lot of emotional satisfaction and happiness to the person involving in hard physical exercise routines. Several feel-good hormones like beta endorphins, melatonin gets regulated secretion leading to mental harmony and better sleep patterns among individuals.

Dance in fitness culture:

The people have realized different values that physical exercise can provide and are now very enthusiastic to be more active through participation in several kinds of exercise programs. Different popular modes of exercise are jogging or running, cycling, trekking, swimming, yoga, weight training or resistance training, dancing etc. There are many other combinations of exercise programs which are very popular among individuals. Among the basic two types of exercise programs as per the sports sciences and exercise physiology, dancing comes under the aerobic exercise program, the other type of exercise is called as anaerobic exercise. An exercise or physical activity that is conducted by getting energy sources from the breakdown of free fatty acids through the process of beta oxidation is called as aerobic exercise. In this form of exercise, the metabolism is mainly with the usage of oxygen and hence this is called aerobic form of exercise.

In non-technical language, any exercise that is carried out for longer duration is recognized as aerobic exercise. Some people are calling this as cardio exercise. It is because the aerobic exercise mainly improves the Cardio respiratory endurance component of the general physical fitness. Hence, regular involvement in aerobic exercise leads to increased cardio respiratory endurance and in turn increased cardio respiratory endurance enhances the time and quality of further participation of the individual in aerobic exercises or cardio exercises. Hence, cardio respiratory endurance and aerobic form of exercises are mutual in functionality.

For improving overall physical fitness for higher order health and better living, individuals need to enhance all the different components of physical fitness in appropriate quantities. As already explained earlier, for prevention of hypertension, heart attack, stroke etc enhanced functional ability of cardio vascular system is essential. For prevention of Arthritis, enhanced immune system and also proper strength, flexibility of the joints is essential. For prevention of lower back pain or disc problem of the spine, individuals need to enhance the flexibility and restitution of the spinal muscles is essential. For several autoimmune problems, individuals need to enhance the immune system capability. Though it is highly essential that individuals have to participate in various kinds of exercises to take care of all these systems of the body, through enhancement in different physical fitness components in appropriate levels, individuals are not seen doing this, just may be because of lack of resourceful knowledge about this.

People are taking part in different fitness activities based on their choice, inclination, attitude and the availability rather than on scientific lines on scientific advice. The present trend in fitness industry is about various western fusion dances like Zumba, Rock, Bollywood dance etc., along with participation in different forms of cross trainings, boot camp trainings, long distance running, triathlons etc. Many are turning towards the fast beat dance forms as fitness providers (***Barbera Vendramin 2016***). Participation in these kinds of dances surely enhances the general fitness of the individuals, specifically the cardio respiratory endurance levels of the individuals. But, this is not in line with the contemplation and scientific ethos of exercise science. The

tenets of Exercise science or sports science prerequisite individuals to be generally fit enough to participate in these vigorous and dynamic dance movements, lest there are several potential dangers lie in participation in these dances like injuries, immune disorders, oxidative stress related problems etc. Hence, dance fitness is essential for taking up dance as a physical training program. Tricky distinction lies between the terms dance fitness and fitness by dance (***Roussel NA, Vissers D, Kuppens K, et.al. 2014***).

Dance revolution as a fitness provider in fitness industry is like a high tide happening and further progressing fast. There are people who want to learn dance for the sake of enhancement in fitness. Hundreds of dance studios are established every year throughout the globe and these are both classical and modern dance schools. Dance industry as fitness promoter is growing in parallel to the global fitness industry. The phenomenon of dance as fitness is not only spreading in western world like never before, the same is true with the Indian scenario of fitness industry. Since, 1990s the dance as fitness provider industry in India is growing rapidly and in recent past the growth is extremely significant. Another interesting and awe inspiring trend is the happening Bollywood dance studios. Fitness freaks are more inclined to involve with dance which is an exercise in physical terms and also very refreshing emotionally and psychologically. There have been several dance studios with independent dance styles

like Salsa, Hip hop, Rock etc. in western sphere, there are dance studios in India with modern and contemporary Indian dance styles.

Bollywood dance style with its fusion values taken from several Indian classical, folk and other western dance movements is the most sought after dance style among the fitness freaks. These dance style studios are flourishing with extreme popularity and patronage. The trends relating to the type of fitness enthusiasts etc. need to be examined further. Biggest setback for dance fitness industry is lack of scientific Curriculum and certification. Several self-styled Bollywood dance style dancers are opening these dance studios, and many a time these dance teachers or trainers might never have equipped with relevant scientific knowledge on fitness components and the intricacies of physical training.

The ever increasing popularity for this Bollywood dance style makes many dance enthusiasts or fitness enthusiasts to get dance training in this style without even considering the setbacks of percussive physical training like practicing the Bollywood style dance moves. Many might think that this kind of percussive and dynamic form of dance would provide higher fitness with better cardiorespiratory endurance and strength leading to enhanced functional health. This may be true, but the science of sports training clearly indicates any kind of percussive and highly dynamic form of physical activity needs to be monitored very scientifically and to be executed with proper rest and recovery. Highly level of condition also presupposes for participation in this kind of highly dynamic kind of dance training (***Yau RK, Golightly YM,***

Richardson DB et.al. 2017). But, the practice seems to be largely different across the globe. Even the beginners are taught the highly explosive dance movements by the trainers without even having a slightest thought that the beginners are prone for physical injuries and sometimes these injuries are so severe and debilitating (***Rietveld AB 2013***). It seems neither the trainers nor the participants do care about this and the probable reason could be lack of sports medicine knowledge among both.

As the mushrooming of dance studio, especially Bollywood type of dance studies are growing, the requirement for the trainers has grown leaps and bounds. Several dance studios are engaging the services of such trainers which only have some limited experience in dancing but no knowledge in the areas of Dance Kinesiology, Dance Physiology, and sports medicine (***Kotler DH, Lynch M et.al. 2017***). Though there are no significant and scientific studies or researches on the issues relating to dance injuries, dance injuries related loss in life satisfaction and other forms of debilitating life post the dance injuries. Since, dance is a dynamic form of physical activity, and more specifically the dance may be treated more of aerobic form of exercise with certain element of anaerobic metabolism also, is itself an oxidative stress due to its dominant oxidative metabolism. While tackling the high loads of intense dance activity, individuals are expected to be predisposed with high level of anti-oxidative potential which may be innate or exogenous. Innate anti-oxidative potential of individuals is mostly decided by the genetics of the person and also on the physical conditioning levels. It is true that the anti-oxidative potential of individuals can become enhanced due to regular physical training of high intensity in nature. But, it is

highly essential for a beginner to have sufficient and optimal levels of anti-oxidative strength for facing the dance training with high intensity movements. Beginners of dance training need to be more cautious and scientific in terms of nutrition management and need to know about the concepts of sports nutrition or physical activity nutrition that is appropriate for dance trainees.

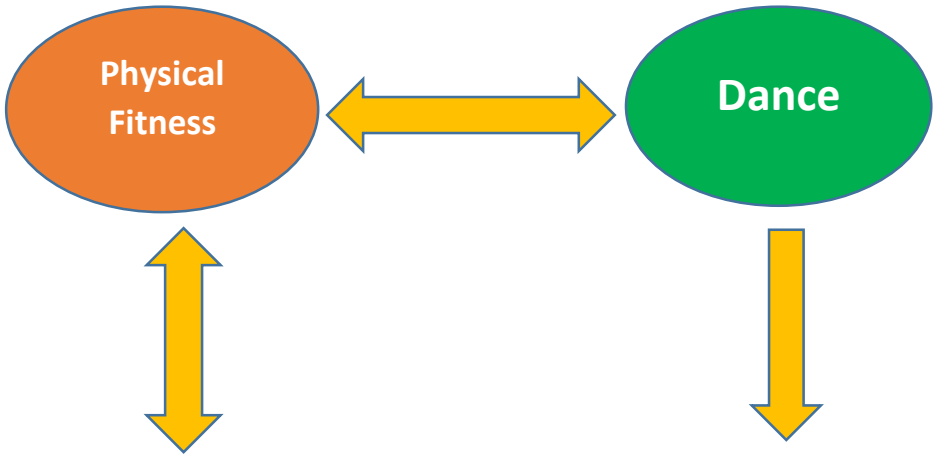
While there is lot of science involved in the area of dance training and participation, dance studios seems to be either ignorant or negligent towards these issues due to many reasons. There are no proper Curriculum based dance training courses incorporating all the elements of dance training, which would make a trainer more scientific in approach for training (***Ojasi Sukhtankar 2016***). While this is highly essential, there is no significant and constructive effort in this direction by the dance teaching institutions and dance studios. Since, the scope of this research is not extendable to the science of dance training to the core level, the scientific concepts of dance training like Dance Kinesiology, Dance Physiology, Dance Nutrition etc. is not discussed at scientific level in the thesis. But, a clearly the perspective of the thesis is to recommend for inclusion of these scientific concepts of dance training.

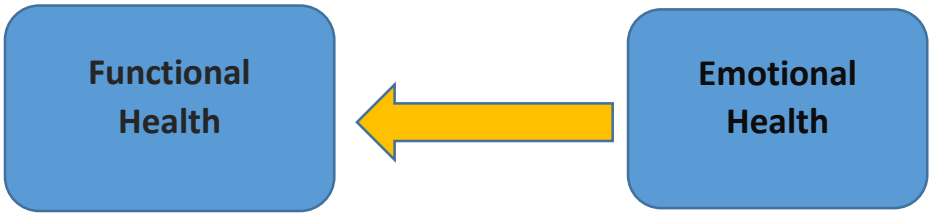
Type of population involved in dance training for fitness is another important characteristic. Dance revolution across the globe is very specific and it is with respect to the type of population involved in dance training and participation for fitness (***Mistiaen W, Roussel NA, Vissers D et.al. 2012***). It is inherent for youngsters to possess sufficient physical fitness unless they are completely inactive or with some

genetic disorders. But, the majority of the dance participants are youngsters. The same phenomenon is also true with respect to the other forms of fitness training and participation like running etc. The proportion of aged, who need fitness in reality is less or rather very negligent. The phenomenon of youth participation in higher proportions in dance practice is not only true for Indian scenario but also mostly true for global scenario. Many factors may be responsible for this trend. Individual need to be physically fit throughout the lifespan for being healthy. The essential ingredient for this is regular and continuous participation in physical activities to keep optimally fit for being healthy. But, very important aspect is to maintain the physical body throughout the lifespan without debilitating injuries and diseases. While most of the degenerative diseases can be prevented through the physical activities, the more significance is attached to the physical injury aspect (***Stracciolini A, et.al. 2015***). Individuals need to be trained so properly that individuals will never experience physical injuries in a very debilitating manner **(Nair *SP, Kotian S, et.al. 2018***). This is possible only through proper and aptly formed scientific training, whether it be physical training, sports training or dance training. Very highly appreciated aspect in physical training is injury prevention. Proper health and absence of injury can make individuals to participate in physical activities without any hindrance, and especially this is truer when it comes to geriatric or older population. The fitness training to geriatric population is very difficult aspect to deal as these populations are more prone for injuries especially the fall injuries (***Jeffrey A Russel 2013***). Dance training being a very dynamic, the older population is at high risk. There are certain physiological

phenomena that would predispose the older population to such risk are loss in strength, balance and proprioception abilities (***Rehfeld K, Muller P, Aye N, et.al. 2017***). These fitness components are highly essential for prevention of falls and consequent fall injuries. But, it is also true that regular dancing might help to foster these fitness components and even the aged can improve the balance and orientation abilities and can avoid such fall injuries. Keen observation reveals that fitness and dance participation are reciprocal and can improve functional health of individuals.

Effect of dancing on the physical fitness and also on the emotional fitness need to be understood to correctly perceive how dance has become part of fitness revolution across globe. People since ages have identified the effect of feel good phenomenon of dance, which synonymously may be called as 'rasa' as mentioned in the Indian classical drama and dance literature. The rasa as mentioned in the Indian dance context may be for both spectators and for dancers, but here the rasa may be limited to the dancing individuals in the sphere of fitness and functional fitness revolution of modern era.





Physical fitness and dance are interrelated. Individuals should possess optimum and apt physical fitness to undergo dance training and dance training increases the physical fitness and further dance training would be made easier for individuals. Physical fitness enhances the physical functioning of the different systems of the body and makes the body healthier. Emotional health is also necessary to maintain proper health and functional health, as emotional stress may disturb the hormonal flow and makes the individual physiologically disturbed leading to lack of homeostasis in the internal environment of the body. Whereas dance participation can bring enhanced emotional fitness through happiness to the individuals participating in dance (***Hotting K, and Rodder B 2013***). This relationship of Physical fitness, dance participation, emotional fitness and functional health of individual might be the one strong reason for people to get attracted towards dance as a fitness medium for their healthy life.

Dance being a noncompetitive group physical activity, people do not hesitate to participate as there is no inherent threats to the ego or esteem, except the kind and quality of dance an individual is projecting which may lead to slightly aberrational expressions of the group members. Except of this inconvenience, there are no external or internal hindrances for dance participation and hence the fitness mongers are taking

up dance as a fitness routine in abundance. Moreover, no additional costs are to be incurred for dance training than a proper dance studio set up for the entire group. Expenditure to set up a dance studio is much less significantly when compared to a general fitness center with heavy state of the art equipment. But, fitness center activities are also highly essential to complement for a dance trainer to protect the several other physical fitness components than the cardiorespiratory endurance.

There are evidences that the ancient human beings in different civilizations had different dance forms which may predispose sufficient fitness and vice versa. There have been several dances which are meant to inspire soldiers of the armies since time immemorial. Several Indian ethnic groups have their war dances which are very dynamic and require so much of physical fitness. They also meant to inspire and infuse strength and confidence among the soldiers. Lack of credible and authentic evidences for using dance as fitness regime during the ancient times, makes it difficult to assume positively. In some of the old civilizations like Hellenic civilization of ancient Greece and ancient Rome, there was a mention about the dance practicing halls and dance teaching to women folk of the ancient Greece and Rome. Mythological revelations indicate that Indians also practiced dance for the purpose of increasing fitness and to get feel-good emotional status. It may be true that the dances were very much a regular aspect of life for ancient Indian women to maintain their fitness and physical beauty. The depictions of sculptures on the walls and projections of temples are ample indicators for this. There might not be any other medium of physical exercise available for women of those days, they might have relied on the dance for the maintenance and

enhancement of both fitness and aesthetics of the body. There may be several hindrances and restrictions for women of ancient times both in India and other places of the world during the ancient times with respect to participation of vigorous physical exercises.

It is clear and unambiguous that dance training and dance practice has become very important element in fitness revolution of the world. Ever increasing demand for dance and mushrooming of dance studio across the globe shows as an indication for this phenomenon. Dance is both physical and emotional, the benefits of dance are broadly dual and these two benefits make individual healthier, vigorous and active in life. Dance with its positive emotional benefits, dance lifestyle and attitude are growing among the individuals across the globe and consequently the dance training as fitness enhancer is ever increasing too.

Relevance of the present topic:

"Dance in fitness culture – an investigation and analysis" was selected at the initiation of the research in consultation with several experts in the fields of dance, physical fitness, psychology, health psychology, sociology etc. An investigation was to be carried out to unearth various elements relating to classical dances, folk dances and other commercial forms of dances with respect to their brief emergency, utility, dissemination and usage to the human kind. The data obtained through the investigation was used to understand and analyze the effect, part and prominence of dance in fitness culture of the past and present scenario. The present research mainly

tries to link the elements of different forms of dance and the possible effect of these dances on the fitness culture and the influence of the fitness culture on dance. The effort is a contra phenomenon which deals about the dance in fitness and fitness for dance. Investigation lead data was analyzed subjectively to form ideas about the fitness culture, dance culture and effect of dance on fitness culture. Extensive interviews, discussions, exploration of books and materials are the main sources of the literature and investigation. Basing on the subjective data, analysis was done to formulate clear and crystallized opinions on the investigation of the topic.

Another sub part of the research was conducting of a small real time controlled experimentation with selected dance form dances on their injury status in response to a designed fitness protocol. The results of the study were to be implanted in to the main stream research of this project to explain the fitness and injuries of dancers. The selected dance forms for experimentation were Bharatanatyam, Kuchipudi, folk dance forms with a control group. These different forms of dancers were undergone with specific fitness training along with their dance training and the effect of the fitness training on the dance performances were measured. This part of the research project gave objective analysis for the topic dance in fitness culture with appropriate strength.

The relevance or the reasons why this topic was chosen would be explained through the different influencing factors of dance fitness and dance for fitness. The topic “Dance in Fitness Culture” is not extended to understand whether there was fitness culture in olden days, whether the dance was a part of fitness culture, whether

how the dance was promoted as fitness medium etc. but limited only to the modern era fitness culture. Some tidbits of information about the ancient dance training and the dance as fitness training in fitness culture were mentioned earlier. Now the more focus is on the modern day fitness culture and how dance has become immersed so deeply to form part of this fitness culture.

Importance of fitness to individual and how individuals are slowly getting interested in acquiring fitness: With very clear scientific and medical evidences, exercise or physical activity seems to be a powerful cost effective pill for health and for prevention of several degenerative diseases and also for enhancing the immunity of individuals to resist event the non-communicable diseases. Exercise endocrinology clearly testifies the above fact with evidences. Enhanced information dissemination techniques like internet and other social media, people are getting aware of this fact and are exhibiting increased interest in exercising for enhanced fitness, health and beauty. More and more people are getting attracted towards active lifestyle. They are also getting themselves educated with respect to different domains of human wellness and are trying to incorporate these things into their lifestyles. The science of wellness of human beings indicates that there are several domains of human wellness, which need to be taken care of simultaneously for achieving higher order health and energetic life. Human wellness science brings out several domains of wellness for human beings, like Physical wellness, Nutritional wellness, Emotional wellness, Social wellness, Spiritual wellness, Environmental wellness, financial wellness etc. and recommends that the individuals need to take proper care of all these different wellness

domains for being healthy. All these different wellness domains of human being influence among themselves and are very complexly interrelated. But, there may be several other wellness domains depending on the persons living conditions and certainly not limited to the above mentioned ones. Individuals have to take care of these different domains simultaneously without neglecting any particular domain because of their interdependency and the interrelated effects on health condition of the person. An example for explanation, a person who undergoes physical training like dance training need to be predisposed of with sufficient anti-oxidative capacity to avoid excessive oxidative stress that emanates from the physical stress of the high intensity physical exercise like dancing. Human wellness science also presupposes for emotional happiness of individual for health, beyond physical and nutritional wellness, lest the individual might suffer with some or the other degenerative health condition.

Hence, there is clear relationship among the physical wellness, nutritional wellness and emotional wellness in terms of health management. Likewise, other intricate interrelationships among the above several wellness domains are to be taken care of without slightest of negligence. This particular knowledge of wellness science seems to be triggering the individuals to explore the best but yet the economical method of achieving many of the wellness domains simultaneously. Whether this knowledge is in real exists among the individuals or not, but slowly the things are moving in that direction. It may be due to the comparative effect of the different physical activity routines the people try and explore and find out the answer for the above seeking. The

constant search for the better medium of health prosperity among individuals seems to be incessant and paving the way to find out the better medium of wellness development.

The derivative values in terms of wellness domains for individuals decide the type of physical activity that in which individuals take part in large number.

Undisputedly, dance can enhance physical wellness, emotional wellness and social wellness domains of individuals which are the powerful vehicles for health and wellbeing. Direct derivative through dance participation is physical wellness, though enhancement in physical fitness and functional fitness of the body. Individuals who participate in dance activity find themselves very energetic, happy and emotionally elated, and this enhances the emotional wellness levels of individuals. Happiness element is one important and very influencing element on the emotional status of the individuals. Most of the fitness mongers participate in group dancing rather than individual dancing, which will foster their social relationships as they mingle with different types of individuals and involve indifferent kinds of group activities. This will certainly enhance the group dynamics and the effective attitude for successful life in society. With these major wellness domain derivatives, dance certainly a dominant form of fitness enhancement during the modern era and hence the heavy following of dance across the globe as fitness enhancer.

Another important element of human endeavor is to become associated with aesthetics, personal as well as extraneous. Humans are known for their relentless efforts to be beautiful and look aesthetic for many reasons. Several techniques and methods have been used for this to achieve since time immemorial. Apart from the techniques like lotions, herbal potions and other nutritional or medicinal techniques, the technique of physical exercise and physical activity has been the very effective all these millennia in achieving the physical beauty for human beings. Sculptures of the ancient Greece and Rome clearly depict the importance of physical beauty and

aesthetics in the life of humans. The various sculptures that exist on the temples and in the temple complexes of the India also clearly reiterate the fact that physical beauty is very important element in human life. It may be difficult to vouch that there were rhetoric evidences that the ancient humans across the globe did use physical measures for enhancing the physical beauty. The written evidences that can state emphatically about these issues may be related to ancient Greece and Rome. The evidences available with ancient Greece clearly mention that the ancient Greek women were not allowed to undergo regular physical training for various reasons except some dancing activities through which they used to maintain their physical beauty to excellent levels. As per the Vedic evidences, though there were no such restrictions upon Indian women, women in ancient India did practice several physical exercise routines for enhancing and maintaining physical beauty and aesthetics of the body and dancing happened as one major medium. Indian classical dances with very high intensity physical movements could cause for heavy burning of calories by enhancing the metabolic rate to high levels. Moreover, the movements involved during the Indian classical dances are highly sophisticated and intensive leading to movement of limbs of the body to their full range of movement during the dance sequences making the skeletal muscles involved in such movements to be very toned and regulated. The dance sequences of ancient Greece and ancient Rome were also of high intensity in the movement with several percussive movements and makes the dances to become highly tone in their legs and torso than the upper extremities. It is evident that the type and range of movements make the body of the dancer to respond in a particular way

causing tone up of different groups of skeletal muscles differently leading to difference in their shape and appearance externally. Hence, the aesthetics of the physical body of the dancers of different dance forms appear differently, but certainly with enhanced beauty and aesthetics with slight differences in physical appearances. The difference in the body aesthetics of the ballet dancer and a Bharatanatyam dancer clearly portrays this. Intensity, direction and magnitude of usage of a muscle group decides the tonus of the muscle and the makeup of the muscle in relation to the other muscle groups making a defined shaped to the body of the individual. The dance which has high intensity, vigorous and higher range of motion might give excellent aesthetics with maximum definition of the body aesthetics. Certainly dance participation and practice makes the body of the individual's more defined and aesthetic. Hence, people are interested in dancing, not only to enhance their physical fitness but also to tone up their bodies to look more aesthetic and beautiful. This is also another strong reason why dance studios are mushrooming across the globe and specially the dance studios with vigorous dance movements like Bollywood dance style studios. With certain caution of sports medicine, dance can bring excellent health fitness and also the required beauty to the individual.

As explained earlier, that the dance participation might cause for debilitating injuries and health problems if not properly done, following all the movement science principles and concept. If not properly prepared physically during the foundation period, a dancer might be prone for several problems including injuries. There are studies supporting that several novice dancers get retired very early in their dancing

career due to these kind of injuries and other health issues that may arise due to faulty and unscientific training protocols. It is really unfortunate for a very young, aspiring and talented novice dancer to have to quit from dancing due to these problems, which can very well be prevented with scientific approach in dance training. Some dance forms are highly percussive and particularly some of the movements of some dance forms are highly dynamic and injury prone, like Tattu Adavu which is performed with stomping of foot flatly in rhythmic manner and Teermanam Adavu which are only basic steps in Bharatanatyam. Though these are basic steps, they are practiced for several times and also are used in the dance sequences frequently by the dancers. These steps are very percussive and produce repulsive forces into the joints due to constant hitting on the ground. There are several such ground reaction force producing steps in many dance forms, especially in Bollywood dance style and also in many of the western dance styles. These steps bring excessive strain on the joint capsules and the surrounding tissues like cartilages, ligaments and muscle tendons etc. Constant and continuous repetitions of these steps without proper foundation to the dancer, may certainly lead to tissue damage to these joint structures and eventually may lead to very debilitating injuries which may last for lifetime and may force the dancer to retire prematurely. Foundation is a process of making the dancer tolerant to these percussive and reactive forces. Foundation training for dancers is very scientific and linear in incremental in a phased manner to see that the bone, muscle components and joint capsule components are stabilized and strengthened. Without this consolidation, dancer is certainly exposed to injury prone conditions during the

dance training. Not only the tolerance, but also recovery from the dance training is equally important. Foundation training not only provides individuals to develop strong muscles, bone and joint compartments but also endows with higher recovery capacity from the tissue damage that might occur during the dance training and practice. Any physical exercise like dance cause for the destruction of tissues at the exercising tissues due to wear and tear, which need to be reconstructed soon after the dance session is terminated or stopped. This regeneration capacity differs from individual to individual, but a person with proper foundation training can have higher order regeneration capacity. Even some of the very talented and famous dancers may also prone for these kind of health risks if they do not properly manipulate their dance training sessions. There were several top level and famous dancers also experienced this kind of problems earlier. There are no credible and scientific studies which verified about the injuries in dance industry, reasons of injuries in dance, financial and other burdens due to injuries in dance industry etc. These are some of the areas where extensive research and outcomes are necessary to make dance more scientific and viable for human wellness endeavor. As there is immense dearth in these studies, this is one of the areas of the present research. Hence, studies on the effect of dance training on the oxidative mechanism of the individuals, tissue damage due to wear and tear during dancing and the possible injury conditions need to take another important aspect in the dance studies.

There is another significantly influencing factor on the dance training, performance and sustenance as a dancer for long time, called conditioning for

dancing. This is the preparatory phase for dance performance, dance training. Every dance training session should be preceded by a proper body conditioning through relevant physical exercises or movements that would make the entire body ready for the prospective dance performance. This is a prerequisite for both a training session and for a dance performance session, to make the movements more effective and reflexive in all areas of dancing, to make the dancer physically aroused for performance and also to make the dancer to be very resilient towards the injury prone conditions. The conditioning for a dancer is in fact a very scientific and slightly complex protocol of exercises or physical movements, depending on the type of dance movements involved in the prospective dance training or dance performance. There must be specific exercises or movements that would make the skeletal muscles and joints of the body very relaxed and resilient through proper stretching protocols. Some exercises or movements need to make the dancer to get in to a physiologically aroused state for proper metabolic assistance for flow of energies during the dance performance, to make the dancer to be more agile, to make the dancers orientation and coordination ability to get aroused etc. There are many such scientific reasons, why a dancer needs to participate in conditioning exercises before start of a dance training or even before the dance performance on stage. Movement science strongly presupposes readiness for participation in intricate physical movements like dance and this readiness is inclusive of physical readiness, emotional readiness etc. This concept of readiness for physical performances need to be a subject matter of dance

teaching to make the dancers more scientific in their approach to dance learning and dance performing.

Another important factor for exceedingly wonderful performance at sometimes by an individual is the presence of flow as per the movement or sports psychology. Flow is a condition in which an individual experiences excellent grace and movement execution even without understanding the reasons for the presence of flow. This is something a tricky phenomenon which is difficult to explain subjectively. But, the sports science has identified this to the biorhythms of the individuals and clearly identified that due to certain biological reason, an individual performs the physical activity with utmost grace and perfection with maximum ease. This necessarily make to include about the biorhythms of dance performances, which can exemplify the reasons and conditions why the individuals will experience a flow of performance and sometimes lack of flow in performance though the conditions are similar for both performances. Though it may be difficult to understand about all those biological processes that would produce this flow in individuals, the conditions associated with the flow may be identified and training may be directed to achieve those conditions before the dance training and performances. Psychological skills training can be the potential method of achieving this flow in physical performances including dance performances. There are several identified psychological skills like visual motor training, Autogenic training and other motor control techniques. The curricular aspects of these skills need to be imparted to the dancers to make themselves a high achiever through self-regulation of their biorhythms. Very negligible number of

research studies have been conducted in this area with respect to dance training, though so many studies are recorded in the sports and movement studies across the globe.

Hence, there are several areas in which extensive research need to be conducted with respect to dance training and dance performances. When it comes to the Indian classical dances the research done is quite less and need more efforts to make these dances more scientific in terms of the training and performances. The present research study encompassed all these important elements which are highly essential to understand the scientific elements of dance training.

Dance fitness and development of dance fitness

Emotional wellness and dance

Dancing and Injury prevention

Conditioning for dancing

Flow of dancing

Psychological skills training for graceful performance

It may be difficult for one single research to be done on the above all factors that may be surrounded with respect to the dance training and dance performance. But, it is ideal to address these issues for prospective researchers to concentrate and conduct research on each of the elements mentioned above. Hence, the present study was aimed to understand these different aspects of dance training and dance performance in the perspective of movement science and to mention the possibilities of the research in this regard. Present research effort encompasses all those elements of dance training and dance performances that would need some critical analysis and possible derivatives. The effort would be to identify these influencing factors of dance and to identify and mention the relevant concepts of movement science, which would become a guiding tools for further research and analysis.

The above mentioned factors which would influence the dance as a fitness medium for individuals have been dealt in this research and were given prominence in discussion and analysis. Among these factors, some factors influence the dance training while some influence the dance performance in dominating manner, but in real terms these are not water tight in character while influencing the dance training and performances but, in fact, they are osmotic in nature. In the same way, some factors are effect of dancing on the physical as wells as psychological domains of the human being. In prominence, fitness for dance, dance injury prevention and management of dance injuries, psychological skills training for higher order dance performances, attaining flow of dancing using the psychological and biological techniques and conditioning for dance training are the factors that are to be kept in mind while dance

training is done. Flow of dancing, dance injury prevention, conditioning for dance performances are some of the factors that would prominently influence the dance performances of dancers and these are the factors that need to be kept in mind while preparing for dance performances and while execution of dance performance. Emotional wellness, dance fitness and the improvement in conditioning level of the dancer are some of the factors that may be identified as derivatives or outcomes of dance training and also of dance performances.

The present research tried to mention about these aspects to certain level to which these would get prominence even in the view point of critics and followers of dance in any form. The main concern of the present research is not to concentrate on either Indian classical dances or on any other specific form of dance, but more weightage and prominence was given for Indian classical dances, Bollywood dance style and some of the western pure and fusion dance forms. The idea was to identify the importance of science of dance and to bring out the reasons and implications of these scientific concepts of dance training and dance performances of any form and style. While doing so the present research also concentrates on the importance of the curricular issues of dance learning and dance performances.

While addressing the above factors of dance training and performances, the present research tries to ascertain the valid and credible reasons and premises, why the dance training and dancing has become a part of fitness regime of several individuals and why the dance has become a highly influencing factor of fitness medium in the

matters of fitness training and fitness culture. Dynamic and interactive literature has been presented to mark this concept and to deliver the views and precincts of why the dance has become a highly impacting medium for dance industry across the globe.

Objectives of the study:

The following are the objectives of the study through which the idea of the research study i.e how dance has become a very integral part of the society and the effect of dance as a medium for gaining fitness both of physical and emotional along with how dance may be instrumental in social and other domains of individuals, was accomplished.

1. *Identifying the elements of dance training and dance performance.*
2. *Understanding and detailing the distinction and relationship between the dance training and dance performance.*
3. *Identifying and detailing the progression of fitness, especially the physical fitness form and how the physical fitness influenced the ancient and modern civilizations of mankind.*
4. *Detailing the revolution of fitness industry and fitness as a medium for gaining health and wellbeing.*
5. *Elucidating the derivative factors of dance training and dancing and illustrating the effect of dancing on the human wellbeing.*
6. *Identifying and explaining the relationship between the dancing and the fitness factors of human health and wellbeing.*

7. *Identifying and elucidating the different factors of dance training and dance performances.*
8. *Making an objective verification of effect of physical fitness factors and the dance performances and vice versa.*
9. *Objective verification of the effect of dance training and dance performances on the factors that might influence the dance training and dance performances.*

Statement of the problem of the research study:

The present research study was aimed to find out the ingredients of dance culture in societies, understand and detail the concepts of dance as training and as performance, delineate the difference between the dance fitness and fitness in dance and also to objectively analyze the relationship between the determinant factors of dance and dance training.

Brief methods of experimental investigation:

The main premise of this experimental investigation was to bring out the importance of physical fitness program on the dancing fitness and consequent changes in different factors of dance performance. This was to highlight the importance of understanding the science of movement studies for the enhancement of dancing

performances of any kind of dance form, whether it be classical, modern or fusion varieties.

A total of four groups with twelve dancers as subjects in each group underwent physical exercise protocol for three times in a week apart from their routine dance practice. Three groups represented Bhratanatyam, Kuchipudi and Bollywood style forms whereas the fourth group assisted as control group for comparison. The physical exercise protocol consisted of different kinds of exercises that were both dynamic, resilient and would work on the overall physical fitness and various physical fitness components of the individuals. This protocol was designed by an expert in Physical education with high degree of expertise and publication history and also the same was discussed with many other movement science experts including sports medicine experts. The total experimentation period lasted for six months and the dance performances of the subject dancers of the four groups were measured by experts in the field of respective dance forms. The dance performance was measured two times, one at the initiation or at the beginning of the study and finally at the end of the study after the six months of experimentation period. Methodology section would explain the details of the dance performance measurement criteria and the method of measurement by experts and also the raw score development for the dance performances of the subject dancers. The pretest and posttest values of the dance performances of the four groups were analysed with the help of Analysis of Covariance (ANCOVA) and further with the Scheffe's post hoc tests for obtaining results of the

study and to make further discussion with respect to the results of the study basing on the statistical analysis.

Delimitations for the study:

Delimitations for the present study were identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

a. *Subjective study delimitations:*

1. *Only outlines of historical edifices are dealt and considered in projecting the ancient and modern historical perspectives of dance.*
2. *Dance culture in ancient India and also in modern Indian context was portrayed keeping in view of the opinions expressed at several interviews with experts, critics and writers on dance.*
3. *Only few forms of dance of India and also of the west were considered for the sake of understanding the dance movement patterns, restrictions, difficulties, rigors of dance, but most of the dances considered for study were of dynamic and percussive in nature.*
4. *Only general trends in fitness culture was considered for the study with special emphasis to the Bollywood dance style.*

b. *Objective study delimitations: (for experimental study to know the effect of specific physical exercise protocol on the performance variables of selected dance forms dancers)*

1. *Age rage of the dancers was 18 to 25 years.*
2. *Only Bharatanatyam, Kuchipudi and Bollywood dance forms were compared along with a control group.*
3. *Each dance group consisted of only 12 dancers.*
4. *All the dancers of the experimentation were from Hyderabad city only.*

Limitations for the study:

Limitations for the present study were also identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

a. *Subjective study limitations:*

1. *Historical edifices of this study may not symbolize and represent the global scenario of dance during the ancient and modern cultures.*

2. *Only few interview and questionnaire circulations through mail may not be representative of the opinion of the whole community of dancers, writers and critics of dance and dance training.*

b. *Objective study limitations:*

1. *The number of subjects in each group and also the age range being large may not significantly influence the effect of experimental variable i.e. physical exercise training on the dependent variables i.e. on the dance performance variables.*
2. *Nutritional and other lifestyle routines of the subjects or dancers was not monitored and may show some effect on the dependent variables of the study.*
3. *Social and financial backgrounds of the subjects or dancers were not taken into account during the intervention due to dearth of availability of dancers and this might show some impact on the results of the dependent variables of the study.*
4. *Since, the control group contained dancers of the three selected forms and they may not be matching in terms of performances and other physical factors with their respective dance form groups of the study and might show some effect on the results of the study.*

Inclusion criteria for the study:

Inclusion criteria for the present study were identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

a. *Subjective study inclusion criteria:*

1. *Only those historical edifices and literature sources which are credible and widely accepted were only consulted and included for the study to portray the historical tenets of dance ethos of both Indian classical, modern and contemporary dances.*
2. *Those interviews and questionnaires which were answered with a credential literature support was only included for analysis.*
3. *The concepts of movement science were taken only when the credential and authentic works are already recorded in accredited journals and literature sources.*

b. Objective study inclusion criteria:

1. *Only those subjects who had understood the whole concept of the experimental research as a sub topic of the whole research were only included.*
2. *Only those subjects who were regular for the exercise protocol only were finally included for the analysis.*
3. *In the control group, four each from three selected forms of dance were included.*

Exclusion criteria for the study:

Exclusion criteria for the present study were identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the

perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

a. *Subjective study exclusion criteria:*

1. *Studies and opinions which are opinionated, dogmatic and with concealed assertiveness on the issues of dance and dance fitness are specifically avoided.*
2. *Studies and books which reflected tenets of dance fitness without significant and sufficient rigorous scientific investigation.*

b. *Objective study exclusion criteria:*

1. *Those who are under regular physical training apart from their regular dance practice were not included in the study.*
2. *Those who are not able to understand the physical exercise science were also not included after conducting an orientation workshop to the prospective subjects at the initiation of the study.*
3. *Those who are on some chronic disorders and are on medicines for chronic time period were also not included into the study.*

Hypotheses for the study:

Hypotheses for the present study were identified and included at the initiation of the study to test in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

Subjective hypotheses: The following subjective hypotheses for the study were initiated at the beginning of the study to test, analyse and to discuss on the results basing on the hypotheses.

1. *Hypothesised that the dance was a medium of fitness maintenance for women during the ancient cultures including ancient India.*
2. *Hypothesised that the dance was a medium of developing and maintaining aesthetic body culture.*
3. *Hypothesised that the dance training and dance performances are vital and inseparable part of human endeavor for health and wellness.*
4. *Hypothesised that the dance with its inherent ability of motivating people for physical activity became a very leading and effective form of physical training for fitness and health enhancement.*

Objective hypotheses: The following Objective hypotheses for the study were initiated at the beginning of the study to test, analyse and to discuss on the results basing on the hypotheses.

1. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the complete body involvement and its subsets of the three dance groups of the study.*
2. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the integration of the limbs of the body and its subsets of the three dance groups of the study.*

3. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the lower and upper limb connection and its subsets of the three dance groups of the study.*
4. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the gross motor movement skills and its subsets of the three dance groups of the study.*
5. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the expression integration and its subsets of the three dance groups of the study.*
6. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive impact on the overall dance performance levels of the selected three dance groups of the study.*

Significance of the study:

The results and the opinions emerge out of the study would show significant impact on the following areas of dance training, dance practice and dance performances.

1. *Create positive environment for the favorable inclusion of dance kinesiology as a curricular subject matter for the dance training and dance study programs.*
2. *The results would bring out the importance of scientific physical training for dancers for injury free and elite performances.*

3. *The results would bring out the significant importance of different physical fitness components on the performance of dance and the dance training.*
4. *The results and opinions of the study would create amenable atmosphere for exploring the importance of taking the interdisciplinary approach for dance performances and dance training.*
5. *This initiative would certainly pave way for acceptable inter-disciplinary approaches both in the curricular aspects of Indian classical dance courses and training and also in the research areas of the Indian classical dances.*
6. *The present initiative would also pave way for bringing out the scientific evidence, how the scientific physical training is highly relevant in the areas of dance training and dance performances of elite dancers also.*
7. *The present study would also enhance the status of dance as a measure of enhancing the health through higher physical fitness and would create more vigorous development in the dance fitness industry.*
8. *The present research with its unique research set up with both subjective and objective research premises, would pave way for more similar kind of researches in the area of Indian classical dances, modern and fusion dances of India and across the globe.*
9. *The study would bring out and enhance the utility of the subjects like movement or exercise physiology, sports medicine, dance kinesiology, dance psychology etc. in the area of dance studies, dance practice, dance training and dance performances.*

CHAPTER - II

REVIEW OF RELATED LITERATURE

This chapter contains the support literature which contain similar studies conducted in line to the present research topic, commentaries, reviews conducted on similar experimental lines, opinions of eminent scholars, but mainly the journal contributions to understand the present research study and also to enhance the central dogma of the present research topic that would make the document more credible and reliable in terms of discussion on results and also in terms of the premise for the research topic. This chapter contains different studies that would enhance the understanding of the present research topic under several sub heads with pooled evidences for understanding the sub concepts of the present study. As the study contains the concepts like the importance of fitness, functional fitness for health, fitness for dance, dance for fitness, fitness culture into dance, dance into fitness culture and also the experimental endeavour with respect to the effect of fitness exercises and dance performances, these different aspects of the research study would be provided with sufficient evidences in support and make the whole study very credulous.

Studies and evidences in support of the importance of fitness and functional fitness for health: Several studies in fitness and health fitness clearly indicate that the enhanced fitness or physical fitness is essential for prevention of many diseases and secure proper health. Fitness is a generic term

which may include different types of fitness like physical fitness, emotional fitness, psychological fitness, social fitness etc. Fitness and wellness experts support for the wholistic fitness for the better health of individuals. Though wellness and fitness are used interchangeably, there seems to be some differences between the two and the wellness being more comprehensive than the fitness. Enhanced physical fitness is an indicator for the enhanced health fitness and enhanced immune status of individuals. Functional fitness shall not be restricted only to the physical variables but need to be extended to the brain functions and enhanced neuroplasticity leading to enhanced mental and emotional fitness. ***Reggie AK, Roder B et.al. (2018)*** have shown that specific form of exercises could induce structural brain plasticity including cortical thickness especially in the areas of superior temporal cortex, precentral gyri. The balance form of exercises was used by the investigators in this regard and found significant enhancements in the brain plasticity leading to enhanced orientation and vestibular processes which are highly essential for self-motion and special adjustment while in movement. This particular neuropsychological fitness is highly essential for highly skilled movements for elite players, dancers and other professionals who are regularly involve in self-guided and complex motor skills. These investigators used balance training for twelve weeks and tested the effect of the balance training on the brain plasticity markers and also on the balance ability of the individuals. They have found enhance neuroplasticity in several regions of the brain and also found enhanced

balance ability. They have observed enhanced special movement ability, orientation ability and cognition ability among the individuals due to the enhanced brain plasticity due to the balance exercises of the experiment.

Any form of dance may influence the health status of individuals through modulation of several fitness factors. Depending on the type of movement, and other factors involved in the dance practice, the individuals may experience different outcomes that might influence on several fitness issues of the individuals leading to improved physical, mental, emotional, neurological fitness. In one of the very important reviews conducted on this area, the one done by ***Hwang PW and Braun KL (2015)*** is very significant. Their review was on the effect of dance on the health of the older adults. They used the PubMed data base and extensively collected the relevant articles published. Out of the many available they have chosen eighteen articles, which passed the stringent rules of review process and analysed the results. They have found several significantly positive changes among the subjects of the studies due to the dance interventions of different types of dance forms. Ball room dancing, jazz, cultural dances, pop and contemporary dancing were used by the researchers of the selected articles. The reviewers found that irrespective of the type of dance form, the individuals got benefitted positively for better health. They identified that the older adults have significantly enhanced their flexibility, endurance, balance abilities, cognitive abilities. These measures of functional fitness could enhance the health status of the older adults of the

several studies and hence they have concluded that the dance training in any of the five selected dance forms for review would bring positive changes in terms of the functional fitness measures and could cause for enhancements in the health status of the older adults.

The fact is that there are very small number of randomised clinical trials in dancing science and hence it may be difficult to identify the scientific outcomes of the dance training on health aspects of individuals. But, the effort of ***Rodrigues-Krause J, Krause M et.al. (2018)*** brought out certain scientific facts on the effects of dance training on the healthy aging. They have conducted a review process to identify the effect of dancing on the functional and also on metabolic factors that might influence the health of the older adults. They searched the data bases like MEDLINE, PEDRO, Cochrane Wiley etc and gathered the data with respect to the randomised clinical trials, semi randomised clinical trials and also observational trials on the effect of dance training on the metabolic and functional factors of health of older adults. Five categories of dance styles studies were included for review and they were cultural dances like Greek dance, ball room dances, aerobic dancing, therapeutic dancing and classical dances like jazz. Their review identified that in overall the dance training of any form of the above had caused for the significantly positive enhancements in the functional health factors like dynamic balance ability, gait ability, muscular strength, cardiorespiratory fitness, flexibility and metabolic factors like glycaemic index, lipid profile,

body fat composition and other oxidative and inflammatory stress factors. For this they have studied approximately 1042 articles and scrutinised them to identify the suitable articles for the review process. They have found only 88 of the articles as suitable for the inclusion of review process and further analysis. This denotes clearly the lack of sufficient randomised control studies in the science of dancing.

Studies and evidences in support of the importance and essentiality of effect of exercises for the enhancement of dance fitness and dance aesthetics for performances: Several fitness factors are essential for undertaking a physical movement or physical skill like dance. It may be difficult to delineate the proportional importance of these different fitness factors for enhanced dance performances. The possibility is of identifying the more important factors in comparison to other fitness factors for enhanced dance performances. Cardio respiratory endurance is one important physical fitness factor that is highly essential for sustained dance performances at high quality expression. There are many methods of training to enhance the cardio respiratory endurance that makes the dancers to not to undergo undue fatigue during the dance performances very quickly. The effort of ***Twitchett EA, Angioi M et.al. (2011)*** is noteworthy in this direction. They have conducted a randomised control trial on classical ballet dancers and in their trial they had tested the aesthetic quality of the ballet performances of the participated ballet dancers both for pre intervention and post intervention. The intervention was

aerobic interval training, circuit training and vibration training for the dancers. They have observed significantly improved levels of aesthetics in the classical ballet dancers performances due to the supplemental training in which they targeted for the enhancement in the cardio respiratory endurance of the ballet dancers.

There are several receptive methods of physical training and exercises for improving the dance performances of dancers, but it is imperative to target a particular fitness component to achieve any significant improvement. Neurological fitness also can enhance the dance performance and dance practice can enhance the neurological fitness. Sports psychologists have long been using a method called Imagery training to impart high level complex sports skills to the elite sportspersons and were successful in their attempt. In the same analogy dance trainers also adopted the help from the neurophysiology training to achieve the required neuroplasticity through the dynamic neuro cognitive imagery training method to enhance the dance skills of the dancers. ***Abraham A, Gose R, Schindler R et.al. (2019)*** have conducted an experiment in which they tested the using of the dynamic mental imagery technique on the dance performances of the university level dance students. They have identified that there were significant enhancements in both motor and non-motor enhancements leading to enhanced comfort in dancing and also several other advantages like enhancements in hip flexion and abduction ranges without any change in the pelvic angle which gives more aesthetics to the dance

movements. They also observed self-reported comfort in kinesthesis and enhancement in the proprioception abilities of the individuals of the study. Enhancements in neuronal fitness could also be achieved through the scientific integration of cognitive imagery training to dancers.

Studies and evidences in support of how the dance may contribute for the enhancement in the functional fitness and health: Dance being a very complex motor skill with neurophysiological origin can influence significantly on the functional fitness of various organs of the body of the dancer thereby enhancing the fitness and health of the individual. Coordination, orientation is some of the very important fitness components that makes individuals to live more comfortably with enhanced ability to adapt to the sudden unforeseen circumstances. Escaping from the accidents is considered as an important aspect that can be attributed to the reflex reactions and coordination abilities of an individual. Dance may cause to enhance the reflex actions of individuals that might make individuals to be able to avert these kinds of sudden situations that may cause vital accidents. Though this aspect may not be perceived by many as a factor of fitness, undermining of this aspect may be very fatal for individuals. In a very important scientific study conducted between professional ballet dancers and untrained control subjects by ***Keifer AW, Riley MA, ShockleyK, Sitton CA et.al (2011)*** it was identified that the professional ballet dancers exhibited higher coordination ability, hip ankle coordination when compared to the untrained controls and this they had attributed for higher

levels of neuro muscular coordination and orientation abilities because of the higher multi segmental postural coordination among professional dancers.

Posture maintenance is another important task the individuals need to concentrate for musculoskeletal health. Any deviation in the posture maintenance or wrong posture could lead to spinal deviations and affect the whole body alignment. Postural defects could bring severe stress on the spinal joints and also on the other joints of the body leading to deleterious conditions. Regular involvement in physical movements especially those movements which produce myriad of patterns are highly essential for individual to get educated neuronally for better posture maintenance. Neuro muscular coordination and neuro muscular facilitation are essential for maintaining the correct and optimal posture. Dance may be used to impart such neuromuscular education among individuals because of the highly complex dance movements. Dance practice can make individuals to carry their body more skilfully with grace so that the posture can be protected with ease. ***Maheu M, Behtani L, Nooristani M et.al. (2019)*** conducted an experimental study to verify the effect of dance training on the postural control task of individuals. They have included twenty four individuals and divided randomly into two groups of twelve each and the groups were dance group and the control group. The dance intervention was the independent variable of the study and the criterion variable was posture control task. The posture control task was measured through the application of modified clinical test of sensory organisation in

balance test. The results indicated that the dance training group could be able to show better vestibular frequency and also sensory frequency when compared to the non-dance group or control group when the sensory motor cues were disturbed. This shows that the dance training could be able to improve the dynamic posture control task ability of individuals.

Very negligible number of scientific studies could be found in Indian dance scenario studying the effect of dance training on the fitness factors and health of individuals. The experimental protocols of the very few available studies are also questionable and need more scientific pursuit. However, there were some studies which endeavoured to understand the science of Indian classical dance and its effect on the various fitness and health markers of individuals. In one such study, ***Sharma M, Nuhamani S et.al. (2018)*** tried to compare the lower extremity muscle flexibility among amateur and well trained Bharatanatyam dancers and non-dancers. In their study a total of hundred and five female volunteers in the age group of 16.2 ± 1.04 years and out of them seventy were Bharatanatyam dancers and thirty five were controls who were non dancers. One way Analysis of Variance was applied to analyse the results from the data collected. In the experiment results they found that in comparison the dance group showed significantly higher hip flexion, hip extension, hip abduction, ankle dorsiflexion and ankle plantar flexion when compared to the non-dancer group. At the same time they also found that there were some palpable differences in lower limb flexibility when compared

between the trained and amateur Bharatanatyam dancers and they attributed the same for the differences in the postures called araimandi and muzhumandi.

It is important to understand and rationalise the issues like the effect of self-perceived health benefits through the dance training and dance exercises. Any factor that contributes in any manner what so ever need to be recognised as a pro active health factor and needs to be examined on scientific lines. One such aspect that needs verification is the self-perceived proactive health factors like self-perceived physical fitness, self-perceived social functioning, self-perceived cognitive abilities. Even the self-perceived proactive health factors could ascertain health benefits to individuals through psychosocial and neuropsychological phenomena. **Lakes *KD, Marvin S, Rowley J, Nicolas MS et.al. (2016)*** conducted a survey research among a total two hundred and twenty-five dancers of both male and female through the community ball room centre. Responses for cognitive, social, emotional and physical benefits were derived through questionnaires from all the participants of the study. The data was put to analysis through Mann-Whitney test and results were obtained. The researchers concluded that experienced dancers (those who were practicing the dance for more than two years) showed significantly higher self-perceived social, physical, cognitive benefits from dance when compared to the novice dancers (those who were practicing the dance for less than two years). They also concluded that the women self-perceived significantly higher benefits in terms of social, physical and cognitive domains when compared to the men of

the research study but these variations they have attributed to the length of the dance training and involvement in community dance programs.

The present research verifies the effects of the aerobic dancing also on the physical fitness aspects and health aspects of individuals without any discrimination from the other dance forms of India or globally. Except for the integrated experiment of the present research study which considered Bharatanatyam, Kuchipudi, Bollywood dance and folk style of India, the genre variations among dances are not seriously considered for understanding the effects of dance on the health benefits. It is also good to cross verify and cross compare with other forms of exercises in terms of the physical fitness derivatives and health derivatives. Globally, some of the dance scientists were very enthusiastic to understand different modalities of dance training on different types of surfaces and compared these different modalities of dance trainings on the several physical fitness and health related fitness factors. ***Sukkeaw W, Kritpet T and Bunyaratavej N (2015)*** in their experimental study tried to bring out the effects of aerobic dance training with two different surfaces on the selected physiological health factors and health fitness factors. They had used the aerobic dancing on mini trampoline and aerobic dancing on hard wooden surface. The physiological factors tested were Bone resorption and health related fitness factors along with the balance ability and applied plantar pressure of the foot. Total of 63 females who volunteered for the study between the age of thirty five to forty five years were included and were

divided randomly into three groups of the study called aerobic dance on mini trampoline group, aerobic dance on hard wood surface group and control group. The intensity of the aerobic training was between sixty to eighty percent of the MHR (maximal heart rate) and involved for twelve weeks, three times a week for forty minutes in each session. Bone resorption was tested through the telopeptide cross linked β-Cross Laps for N terminal propeptine of Procollage type I. One-way Analysis of Covariance (ANCOVA) and paired t test were used to analyse the data to find the results of the study. They found that both the activity groups showed significantly reduced bone resorption and showed enhanced bone formation when compared to the control group which had not performed any activity. They also concluded that there were significant improvements in health related physical fitness, balance ability and also in the foot plantar pressure application of the activity groups when compared to the control group. This indicated that the dance training on any surface may be advantageous for enhancement of the health fitness components and only important consideration may be the injury proneness of the surface used for dancing. Indian classical dance forms with their exquisite movements and expressions would be able to inspire individuals to completely immerse in devotion to the dance activity. These dances apart from providing emotional health to the spectators, they may also be able to provide excellent health benefits to the dancers too. Several experienced dancers and professional classical dancers of India wrote several commentaries about these health

benefits. ***Arpita Chatterjee (2013)*** described the Indian classical dances as active and non-competitive form of exercises to the dancers that would provide excellent health benefits. She believes very strongly about the therapeutic effects of the Indian classical dances as they are both physical and neuronal in their effect and origin. With varied dance movements across different dance forms like Bhangra, Bharatanatyam, Kuchipudi, Chau they all contribute for different types of powerful and soft movements with different effects on different body organs leading to therapeutic effect as these movements bring wholistic involvement. She expressed that Indian classical dances can contribute for higher order balance abilities, flexibility, strength of the body and consequent health benefits.

Harsha Khandelwal and Uma joshi (2016) in their experiment identified that the NAVRAS dance therapy of Indian classical dance would bring significant positive changes in the emotional intelligence of the individuals leading to higher order emotional management abilities to individuals. They have conducted an experiment in which they used the dance therapy as an intervention program. 200 senior secondary students including boys and girls were included for the study and were divided into two groups as dance group and control group with hundred students in each group. The dance group was given NAVRAS dance therapy classes for fifty sessions and the results of the study showed significant improvements in the emotional intelligence of the dance group students when compared to the control group

students. This clearly indicates that the Indian classical dances may bring positive changes in the emotional wellness of the individuals who participate in the Indian classical dancing activities though they have not confirmed whether the spectators of the Indian classical dances might also experience the same positive change in terms of emotional intelligence and emotional wellness.

Shankarashish Mukherjee, Neepa Bajerjee et.al. (2014) conducted a scientific anthropometric study on the effect of Bharatanatyam, Kathak dance practice individually and in combination on the body composition status of Bengal females. They have collected the anthropometric data from the Bengal Indian classical dance practitioners who have been practicing Bharatanatyam, Kathak dances. They have found more favourable body composition among the dancers who have been practicing both the Bharatanatyam and Kathak dances when compared to those who practice either Bharatanatyam or Kathak individually. Between Bharatanatyam and Kathak practitioners, the researchers found that the Bharatanatyam group sowed more favourable body composition when compared to the kathak dance practitioners. They have attributed these variations to the intensity, volume of dance practice by the dancers. More vigorous and more intense dance practice could bring favourable health benefits in terms of body composition of the individuals in similar lines to the exercising effect.

Dance with its multifarious effects could bring positive changes not only in physical health of individuals but also mental and emotional health of individuals. This is one important advantageous factor that makes the dance a special tool of fitness in the fitness industry. Wellbeing tendency is highly essential for individuals to enhance the inherent life satisfaction though enhanced health consciousness. Higher the health consciousness higher will be the life satisfaction though better health management. Dance may be used as a tool to achieve this triad for health enhancement in individuals. ***Parkin Sil, Kimji-young, Cho Soon-Jeong et.al. (2015)*** conducted an extensive review to identify the relationship between the wellbeing and life satisfaction thought enhanced health. For this they have analysed five hundred and eleven surveys conducted. After checking the reliability analysis and frequency analysis, they have analysed the results of the review. They have concluded that the community based dance program participants showed significantly better wellbeing tendency than individual dance program participants and also the higher life satisfaction and better health status.

Studies and evidences in support of the effect of dance on the neuroplasticity and neuroaesthetics of the dancers and the spectators: This is one of the very significant aspects of dance influence which needs to be examined with credible and reliable studies. Neuroaesthetics may be a relatively new concept that would explain about the perceptions of the dancers, spectators and others in terms of the dance aesthetic sense. Dance may be

recognised as a very credulous form of recreation, inspiration and cultural evolution too. Dance may be recognised as a special form of aesthetic movement which might influence both the dancer and the spectator in different ways leading to different types of plasticity in brain that might cause for different effects on the emotional, neurobiological and aesthetic aspects of the individuals. Enhanced neuroplasticity of brain areas affect the emotional, cognitive domains of the individuals very significantly, consequently enhanced behaviour in terms of perception of aesthetics also. Variations in perception of aesthetics might cause in variations for the differential behavioural reactions to different art forms by different individuals. ***Teixeira-Machado L, Arida RM et.al. (2018)*** have conducted a well-managed review on the effect of dance on the neuroplasticity of brain and consequent effects on psychomotor adjustment and other functional changes of the brain. They have identified and concluded that the dance can significantly influence for the enhanced neuroplasticity of the brain areas like hippocampus, grey matter of the precentral and Para hippocampus, though there may be qualitative differences in terms of the neuroplasticity depending on the dance patterns and the effect of the neuroaesthetics. They have also identified the evidences about the effect of dance in terms of its integrative effect on the brain functions and brain enhanced functions like cognitive ability, memory, attention, perception etc. Cognition, perception might influence for the variations in the neuroaesthetics of individuals concerned.

Dance causes for the positive neuroplasticity leading to enhanced brain functions though mediating enhanced BDNF pathway etc. In one of the very significant and latest reviews on the effect of dance training on the neuroplasticity was recently done by ***Lavinia Teixeira-Machado, Ricardo Mario arida et.al. (2019)*** in which they have tried to find out through the review about the effect of dance training on the brain volume and function. For which they have studied one thousand and seventy one studies in total as per the PRISMA guidelines. In their meta-analysis and review they have found that dance training could cause for the improvements in brain volume in hippocampal area, Para hippocampal gyrus and also found enhanced white matter integrity in these areas. With respect to the functional changes of brain through the dance training, they have found that there was improvement in memory, body balance, attention and these improvements were possible due to enhanced peripheral neurotrophic factor due to positive neuroplasticity due to dance training.

Blasing B, Calvo-Merino B, Cross Es et.al. (2012) in their path breaking review article, have conducted review on how the individuals might perceive the dance movements leading to variations in the attention, cognition, perception etc of the individuals. They have included studies which tried to measure or find out the effects of neurocognition in the areas of expression and observation of dance by individuals that might result in their neuroaesthetics perceptions. In their review they have identified several scientific studies that

examined the effects of dancer's sequential abilities during the highly complex coordinated movements, effect of timing and synchronised efforts of dancers on the audience's perception in terms of dance movements, attention and synchronisation of highly skilled dance movements coupled with the music that would be played along with the dance sequences. This special characteristic of the dance, which would foster for the special environment that would enable both the dancer and the spectator to engage in differential attention, coupling, coordination, orientation and perceptual experiences that might lead for the variations in the neuroaesthetics both in dancers and the spectators.

Dance has been the intervention program as a treatment protocol for the psychiatry disorders and neurological problems since time immemorial. In fact, there were several ancient dances across the globe which were recognised in respective cultures as dances for social and mental rehabilitation. ***Vittorio A Sironi and Michele A Riva (2015)*** have narrated several such dances which have been in use since time immemorial as dances for social and neuronal rehabilitation in various cultures. They have identified Dionysia dance in Ancient Greece, St Vitus dance in the middle ages in Europe, Tarantism dance of southern Italy as some of such dances. Though there have been several forms of dances in India since time immemorial there were no efforts to find out the effects of these several dances of ancient India or of modern India. It would be ideal to examine and understand the characteristics of these Indian dances in

terms of the human transition endeavour and to recognise into various categories as per the cultural significance.

Wellbeing seems to play a vital part in making the people to perceive positive lifestyle and positive attitude towards healthy life. There were several attempts to understand the source of the feeling of wellbeing among individuals though it may be linked to brain areas of the individuals. Many scientists have differentiated between the pleasure and wellbeing and wellbeing is identified as a healthy sign for individuals. Deriving wellbeing feeling is possible through exercise, sports and dance participation. Several studies conducted research to understand the beta endorphin link to wellbeing feeling of the individuals. Studies were also conducted to find out which type of physical exercise can initiate the euphoric feeling and wellbeing feeling among individuals. ***Eloise A stark, Peter Vuust et.al. (2018)*** in their review and communicative article tried to explain the wellbeing feeling and also tried to hypothesise the origins of this wellbeing in the brain activity. They have proposed that the individuals when involved in music or dance programs, they might initially experience pleasure and in long time the people might start identifying themselves with the feeling of wellbeing because of the neuroplasticity and brain changes. The researchers also used the neuroimaging technique to understand and find out the exact areas of the brain areas which are responsible for the wellbeing feeling, but only hypothesised that there may be a default mode network that is responsible for this. However, they have confirmed that the wellbeing feeling can be generated

into individuals if the individuals were put to pleasurable physical activities for long time which bring adaptations in the brain.

Studies and evidences in support of the effect of exercise revolution, fitness culture and the effect of fitness culture on the dance culture and dance: The world is experiencing disease epidemic and is reeling under the pressure of ill-health. Lifestyle degradation could be one strong factor that is causing global ill health and slowly the society is recognising the importance of good life style for better health. There are many factors that might contribute for the better health like active lifestyle, good nutrition, emotional stability etc. People have very well understood the immense positive effects of exercise or physical activity and the whole globe is tilting toward the exercise mania. This seems a better trend that would fetch a positive results in terms of health of the world. Exercise in any form may be encouraged to gain the health benefits and if multitude of health benefits are possible through a single form of exercise it would be more beneficial to the human kind. Since, dance may be considered as a non-competitive exercise form the dancers can enjoy the movements very thoroughly and can derive both physical and emotional benefits. Since, the health is not simply the physical but includes mental, emotional, social etc, it is highly desirable to have all the heath benefits through some form of exercise. Involvement in sports and exercises may bring the health benefits but involvement in dances would bring myriad of health benefits simultaneously and hence dance participation may be considered as a beneficial form of

physical activity. Dancers also have the comparable fitness levels when compared to the sportspersons of any rigorous sport. Dancing enhances the fitness and hence the exercise and fitness industry is looking towards the dance as a form of physical activity. There were several studies which scientifically proved that dancers also possess high and similar form of physical fitness when compared to sportspersons. ***Angioi M, Metsios GS et.al. (2009)*** conducted a review to bring out the profile of the contemporary dancers with respect to the aerobic fitness, anaerobic fitness, body composition and muscular strength. They also conducted review to bring out whether further exercises are essential just like sportspersons to enhance the dance performances of contemporary dancers. In their review they have identified that the contemporary dancers of various levels showed different levels of aerobic fitness, anaerobic fitness, body composition and muscular strength but they can be compared to the sportspersons of the rigorous sports in terms of these factors. Their review also confirmed that the contemporary dancers need additional and supplementary exercise training to improve significantly their dance performances just in line with the sportspersons of rigorous sports. Hence, the study indicated that the contemporary dancing can improve the fitness and fitness can improve the contemporary dance performances.

Several studies have identified that regular involvement and practice of dance of any form may lead to enhanced physical fitness factors and hence the dance intervention has also become a part of the fitness programs of modern

era. Since the dances like Bharatanatyam may not only provide enhanced physical fitness but also the emotional and psychological wellness due to the expressive content of the dance, these dances may also be included into fitness training program to derive dual benefits. ***Mithin Anand and K Vaithianathan (2016)*** in their experimental endeavour tried to find out if there was any effect of Bharatanatyam dance training on the lower back flexibility measured by sit and reach test and explosive strength measured by standing vertical jump test among the selected students of a particular university in which they were studying. The Bharatanatyam dance intervention was provided for sixty minutes' session for five times in a week for around three months. The pre intervention and post intervention data of the sit and reach test and vertical jump test was analysed using the paired t test at a significant level of 0.05 and they had found that there was significant improvement both in the flexibility measures and also in the explosive strength measures and hence they recommended Bharatanatyam dance training as a fitness program to enhance functional health elements of individuals.

The modern day fitness centres are using dance as an important intervention for bringing positive changes in the functional health of the individuals. There have been several forms of dances which are now used as fitness intervention programs across the globe. Zhumba is one such famous variant of dance that is extensively used in India. In recent past there was sudden increase in the usage of Bollywood dance form as the fitness program

in several fitness and dance studios for enhancing fitness levels of both young and older people. Mainly the dance is used in fitness studios to improve the cardiorespiratory endurance and cardio respiratory functional health of the individuals. ***Josianne Rodrigues_Krause, Juliano Boufleur Farinha, Thiago Rozales Ramis Fransesco et.al. (2018)*** in their cross sectional study investigated whether what kind of aerobic dance intensity may be used to improve significantly the cardio respiratory parameters for functional health in older adults. They selected ten aged women in the age of around sixty five years and conducted aerobic dance sessions at three different intensities like familiarisation intensity, medium intensity and maximal intensity. The parameters tested were peak oxygen consumption (VO2 peak) and First and second ventilatory thresholds (V1 and V2). They have observed through the data and analysis of data, that even the low intensity aerobic dance training could bring significant enhancements in the above three parameters of the cardio respiratory health of the older individuals of the study.

Across the globe, dance is now extensively used to achieve the health targets of individuals and society. There are several organisations and cultures across the world are using dance as a medium of socialisation and health enhancement tool. Since, dance is a special medium which encompasses both physical and neuronal elements in it, dance could bring out specific health benefits to individuals by increasing the physical as well the mental health factors. In a semi longitudinal and cross sectional study conducted by ***Krista***

Schroeder, Sarah RN, Ratcliffe J et.al. (2017) the longitudinal health benefits through dance activity were examined. They have conducted a study in which a total of five hundred and twenty one subjects participated across a span of four years during which they attended various community dance programs were attended. The researchers collected information relating to the satisfaction level in attending the community dance programs, exertion levels perceived, target heart rate achievement etc. The data was collected by the researchers during the four years period and on further analysis they found that most of the participants perceived the program participation as highly enjoyable and expressed high satisfaction. The researchers analysis also revealed that most of the adults who participated in these community dance programs across the years felt that they have achieved the target rate of the heart. These programs were more favourable for the elderly than the young participants. Hence, the community dance programs bring high success rate in terms of achieving the target health benefits to the society and hence dance may be used as the important medium for enhancing the health status of the individuals.

With increasing awareness on the importance of dance in achieving wholistic fitness, more and more attention is paid towards understanding the effects of different types of dances as different types and forms of dances might impact differently on the individuals due to their differences in terms of intensity, involvement, music played along, expressions etc. There have been several studies now trying to elicit the effects of Zumba and salsa dances as

they are very favoured dances for fitness training across the globe and even India has witnessed exemplary demand for Zumba dance. In fact, it needs to be acknowledged that the entry of fast dances like Zumba brought significant change in the fitness industry as people became very attracted towards the dance form for enhancing their fitness across age groups because of the appeal it produced on the populace. It seems that the fitness culture in India and also across the globe changed drastically with the entry of Zumba and salsa dances into fitness industry. ***Pablo A Domene, Hannah J Moir et.al. (2016)*** in their experimental study tried to find out whether there was any difference between the salsa and Zumba dance participation of individuals with respect to their maximal oxygen uptake, maximal heart rate and wellbeing perceptions. They also tried to find out whether there was any difference if the individuals performed both dances with and without partners on the criterion variables. For this they have included twenty four individuals in the age group of twenty two to fifty six years who attended salsa and Zumba dance classes in a community centre in London. They have observed that there was significantly higher total time spent and higher intensities achieved in both the dances when the dance training was done with partners than without partners. When compared to Salsa dance training, the researchers found that the Zumba dance training brought significantly higher maximal oxygen uptake, higher heart rate achievement and higher wellbeing scores. Wellbeing scores seems to be very much impacting in terms of the health status of the individuals.

Studies and evidences in support of the effect of fitness on the dance performances of various dancers: Dance performance of elite in nature requires high levels of physical, mental, emotional fitness and the sub factors of fitness. There are several factors of physical fitness like strength, endurance, flexibility, coordination ability, agility etc that might influence the dance performances of dancers. These factors of physical fitness are required in a specified proportions to make the dancer comfortable in performing the complex dance movements. Though it may be difficult to clearly identify the prominent factors of physical fitness for excellent dance performances, it is but sure that all the factors are highly essential in some proportion for better dance performances. Several research studies in dance tried to assess and understand the influence of these physical fitness factors either individually or in combination on the dance performances. ***Twitchett EA, KoutedakisY et.al. (2009)*** in their review article assessed the effect of the physiological fitness components and the professional classical ballet performances. Several dancers of the recent origin are incorporating the other complimentary training protocols to enhance their fitness factors like strength, cardio respiratory endurance, flexibility etc to enhance and to protect their dancing performances. The dictum of the fit for purpose has been highly recognised in the modern dance scenario and hence the recent trend in inviting the fitness programs into the dance practice regimen of the dancers. Including the undesirable hypertrophy of the muscle that might hinder the aesthetics of dance

performances is also a recognised physiological fitness factor for dancers. Regulation of body fat percentage and body weight have become an essential ingredient of the dancers as a measure of physical fitness.

The recognised scientific fact is that the dance training and dance performances on regular basis could foster for enhanced physical, physiological, emotional and neuronal fitness. It is more visible and prominent in physical fitness variables and these variables also influence the dance performances of the dancers. Regular dance training and involvement could enhance the various physical fitness variables in different proportions basing on the type of movement and sustained effort of the dance movement. Hence, the improvement in physical fitness factors may be cross linked to the type of dance form and dance movements regularly used. Several scientific studies tried to find out the differences in different physical fitness parameters among different forms of dancers of different genre and of different geographical areas. ***Wyon MA, Harris J, Adms F et.al. (2018)*** have conducted a similar study between the breaking style and new style elite hip hop dancers. Basing on the physical and physiological demands of the different types of dance forms, there may be variations in different fitness factors, especially on the cardiorespiratory fitness parameters. To measure and to quantify the cardio respiratory endurance of a person, exercise physiologists use the parameter of VO2 max. This is a scientific indicator for understanding the level of cardio respiratory endurance of a person. Higher the VO2 max, higher would be the

cardio respiratory endurance and the fatigability will be less during the physical exertion especially like dancing. The researchers had found variations in this parameter between the two styles of elite hip hop dancers of the study. They have found that the break dance style of hip hop dance demands higher cardio respiratory exertion causing for higher endurance and hence they had found higher VO2 max values when compared to the new style of hip hop dancers.

The established scientific fact is that the dancing being a physical activity coupled with the psychological involvement, both physical and mental fitness could foster for better dance performances. Improved physical fitness could lead to better dancing performances. It is also important to recognise the functional fitness needed for the dancers basing on the type of dance involved regularly, which would enhance the functional fitness levels of the dancers which fosters for the enhanced and easier flow of dance performances by the dancers. Though this is very well established by several scientific studies in dance research in India and across the globe, dancers are rarely involved in special and supplemental physical and mental training for enhancement in dance performances. ***Clippenger K (1997)*** reiterated this scientific fact way back in 1997 and explained why the dancers need higher fitness in order to enhance their dance performances and vice versa. He clearly indicated that the dancers can enhance their fitness and health by dance participation. According to him dance participation and dance practice alone can enhance the physical fitness and so the health of the individuals. But to enhance the dance

performance levels and for grace and ease in dancing he recommended higher levels of fitness.

There may be certain indirect factors that would contribute for relevant fitness components that might contribute for enhanced sports performance or dance performance. Certain individual fitness factors like balance ability, coordination ability, orientation ability, proprioception ability and such other factors contribute for the dance performances. Enhancements in these individual factors could also promote the skill level of the dancers leading to improved dance performances. Hence, dancers may try to improve these individual physical fitness components separately though specialised complimentary training to embellish their dance performances. There were studies which supported this concept. ***Nilesh Andhare, Ujwal Yeole et.al. (2018)*** in their randomised control trial, tried to find out whether the intrinsic muscle training to the foot muscles would bring changes in the balance abilities of the Bharatanatyam dancers or not. They hypothesised that the Bharatanatyam dancers might develop flat foot due to regular foot strike and several tapping dance movements and they also hypothesised that the correction in the foot muscle dynamics could bring back their balance abilities which might be affecting negatively due to the perceived flat foot of the Bharatanatyam dancers. They have included sixty dancers for this study and randomly divided into two groups and one group attended regularly foot tapping exercises for four weeks and the other group acted as a control group

which did only Bharatanatyam practice but not the foot exercises. The investigators obtained the balance data through the Berg Balance scale and the flat foot details through the foot posture index. Both the pre test and post test values were compared and they had found that there was significant improvement in the balance ability of the Bharatanatyam group which underwent the foot posture exercises when compared to the control Bharatanatyam group.

Studies and evidences in support of the effect of fitness with respect to enhancement of dance performances and prevention of dance injuries: Dancing is a highly sophisticated and very complex motor skill that necessitates with high degree of functional fitness marked by fitness factors. Increased fitness may enhance the dance performance and vice versa. Dancing not only prerequisites for physical fitness, also demands high levels of mental, emotional and cognitive fitness, especially when it comes to the Indian classical dances like Bharatanatyam, Kuchipudi etc. Significantly high levels of these finesses would certainly foster for excellent dance performances by the dancers. The exercise or sports medicine experts also indicate that functional and specific fitness is essential not to be get injured during the physical activities like dancing. Dancing being very impacting physical movements, might cause for several injuries if suitable preventive steps are not taken. One of the very potent measures for prevention of injuries during the dancing could be enhanced functional fitness of the whole body, or especially

the relative fitness for the specific dance patterns, keeping in view of the kinesiological necessity of the dancer. Various possible premises for injuries during the dancing may be physical imbalance, postural imbalance, mismatch in neuro physical coordination etc. There have been several such premises identified for dancing injuries, and enlistment of these may not be the scope of this research. One of the such strong premises is core stability and core strength of the individuals. ***Rickman AM, Ambegaonkar JP et.al. (2012)*** in their review article tried to identify the possible implications of core stability for the dance injuries. Core stability may be identified as the level of stableness in using the lumbar pelvic hip complex while executing the dance movements or highly complex physical skills. Higher levels of core stability could provide enhanced stability in executing these complex dance movements without any strain and also with ease. Insufficient and reduced core strength reduces the core stability of the individuals leading to inferior quality dance movements with improper coordination, range of movement and speed. The dance kinesiologists have identified that the core muscles work in a very coordinated manner for every complex movement in a unison, and in preferential sequences to accommodate the highly volatile and complex dance movements. In fact the exercise medicine experts clearly recognised that insufficient core strength and insufficient muscular strength could reduce the joint stability of the hip and other joints leading to injury proneness of the joints. Inadequate strength in the muscles that protect and work on a particular joint, would certainly result in

severe stress on the joints while dancing leading to injury to the dancer that might certainly affect the further performance of the dancer. The dancer needs to maintain the core stability throughout the dance performance for excellent manifestation of dance sequence for the best perceptual aesthetics of the spectator and also for the dancer self. There may be many fitness factors that could contribute for the enhanced and prolonged core strength of the dancers like muscular endurance, cardio respiratory endurance, muscular power, essential coupling and coordination abilities etc.

Among the several physical fitness factors the factors that might influence strongly on a particular dance form or particular dance movement needs to be recognised for better regulation and upgradation of dance movements through special concentration on these highly influencing physical factors. There were several such studies in the dance kinesiology, dance physiology which tried to identify the influencing physical fitness factors on the dance performances of certain forms of dances. Delphi study conducted by ***McCormack MC, Bird H, De Medici A et.al. (2018)*** may be recognised as such study which studied the effect of the selected physical fitness factors on the professional ballet dancers. They used opinion survey software and the targeted respondents were professional ballet dancers and the sports medicine experts who attended the ballet dancers injuries for several years. They tried to ascertain the relative importance and the importance of the several fitness factors in view of these two categories of respondents for the open ended

questionnaire and further analysis was done. Through their questionnaire survey research they have found that the flexibility and the strength are the two prominent and important physical fitness factors for the professional ballet dancers.

Review research done by ***Rafferty S (2010)*** clearly indicated that dancers need to undergo supplemental training in similar lines to an elite sportsperson recognising the need to the specific functional fitness for the dancers of different dance forms. Keeping in view of the requirement of the fitness levels and the type of fitness components that may influence significantly the dance performances, the author has recommended that the dancers need to concentrate on the additional training for the enhancement in fitness levels for better and easier dance performances. Steadily the fitness training has been an integrated aspect of the dance training and especially this is highly practiced in the western world dancing scenario. Integration of fitness training is an essential ingredient to not only to enhance the dance performances in terms of physical sustainability and also aesthetic sustainability. Dance physiology and dance kinesiology subjects are growing globally and is enhancing the dance trainability.

Dance medicine or exercise medicine experts are very much concerned about the prevalence and occurrence of dance injuries among the various forms of dancers. There are several factors that might cause for variations in the

incidence of injury among various forms of dancers, factors being the intensity of the dance form, preparedness of the dancer, longevity of the dancer in the dance performances etc. Prevention is the best remedy for the dance injuries and hence a scientific preparation of dancer on the principles of dance physiology, dance medicine and dance kinesiology is highly essential to avert injuries. Generally, with increased awareness, understanding and awareness the professional dancers need to be more immune for injuries when compared to the novice dancers. But many a time, the things are different and the same was confirmed through the study of ***Smith PJ, Gerrie BJ, Varner KE et.al. (2015)*** in which they have found that the professional ballet dancers showed higher incidence and prevalence of dance injuries when compared to the amateur ballet dancers. They have found that the incidence of dance injuries among the professional dancers was 1.46 per 1000 dance hours when compared to 1.06 among the amateur ballet dancers for every 1000 dance hours.

Dancers need to undergo supplemental and complementary fitness training sessions to not only to enhance the dance performance and also to prevent possible injuries. Cross training is one such aspect of training for the dancers in similar lines to any other sportsperson. ***Matthew Wyon (2019)*** clearly emphasised with scientific evidences that cross training for the dancers would not only significantly improves the dance performances of the dancer by improving several fitness components and also making the dancer more sustained during the dance activity but also improves the injury prevention

capacity of the dancers. Higher physiological status and physical fitness parameters could enable the individuals to perform dances at a higher intensity with more vigor and with comfortable ease.

CHAPTER III

METHODOLOGY

This chapter contains the explanatory note on the methods and materials used for conduct of this study. As the present study consisted of two approaches, viz subjective approach and objective approach in conducting the research, both the procedures were explained here. The subjective approach contains the identification of certain issues that are to be identified in relevance to the title of the research topic, discussed in consonance to the credulous materials and methods like studies concluded in this regard, commentaries made by experts in the field of dance, fitness and wellness, reviews conducted by the expert and published in well-known journals and the results are derived to make conclusions. The other approach, i.e. objective approach is an experimental study within the present study as a sub unit, which examined the effects of the selected physical exercise protocols on the dance performance components of few selected dance form dancers. The methodology contains the two sets of descriptions of the procedures, methods, objectives and hypotheses relevant to the two types of researches included for the study. Hence, the present chapter entails for the inclusion of the two procedures adopted for the two types of the researches included within the present topic of research.

The subjective study of the research:

This part of the study as already explained, contains the identification of certain issues that are to be addressed, examined and analysed in terms of relevant materials and sources to derive the analytical results and conclusions. For this four

important issues that were taken for verification were A. Whether the dance activity had been a part of fitness culture revolution, B. Whether the dance had been a medium of developing and maintaining aesthetic body culture, C. whether the dance training and dance performances had been inseparable part of human endeavour or not and D. Whether the dance has the inherent ability of motivating the people or not and thereby the dance could be considered as an effective tool for fitness and health enrichment or not.

Objective approach and experimental method of the study:

The main premise of this experimental investigation was to bring out the importance of physical fitness program on the dancing fitness and consequent changes in different factors of dance performance. This was to highlight the importance of understanding the science of movement studies for the enhancement of dancing performances of any kind of dance form, whether it be classical, modern or fusion varieties. Keeping in view of the perspectives and the research outcomes of different dance researchers, the scholar has identified with the help of sports scientists, movement scientists, the following different components for contribution to high level dance performances. There are five major components identified to be tested with different subsets of components as indicated in the table below. The following are the dance performance components and the aggregate was considered as the overall of the each of the component and aggregate of the different components was considered as the overall dance performance of the dancers.

S. No.	Name of the Component	Name of the subset component
1	Complete body involvement	Axial control
		Locomotor status
		Energy Maintenance
2	Integration of limbs of the body	Core support
		Spinal Involvement
		Integration of segments during dance
3	Coupling and Coordination of Lower and upper limbs	Lower limb connectivity to overall Movement
		Upper limb connectivity to Overall movement
4	Gross motor movement skills	Agility
		Balance
		Speed dynamics
5	Expression integration	Expression quality
		Connectedness of expression with music
		Connectedness of expression to flow

A total of four groups with twelve dancers as subjects in each group underwent physical exercise protocol for three times in a week apart from their routine dance practice. Three groups represented Bhratanatyam, Kuchipudi and Bollywood style forms whereas the fourth group assisted as control group for comparison. The physical exercise protocol consisted of different kinds of exercises that were both dynamic, resilient and would work on the overall physical fitness and various physical fitness components of the individuals. This protocol was designed by an expert in Physical education with high degree of expertise and publication history and also the same was discussed with many other movement science experts including sports medicine experts. The total experimentation period lasted for six months and the dance performances of the subject dancers of the four groups were measured by experts in the field of respective dance forms. The dance performance components and dance performance were measured two times, one at the initiation or at the beginning of the study and finally at the end of the study after the six months of experimentation period. The experts in the field of respective dances selected for the experimentation were requested to quantify the dance components of the dancers participated in the study. The experts had measured independently about the sub sets, components and overall performance of the dancers and the scores were awarded. The score sheets were incorporated in the appendix.

Delimitations for the study:

Delimitations for the present study were identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

c. *Subjective study delimitations:*

5. *Only outlines of historical edifices are dealt and considered in projecting the ancient and modern historical perspectives of dance.*
6. *Dance culture in ancient India and also in modern Indian context was portrayed keeping in view of the opinions expressed at several interviews with experts, critics and writers on dance.*
7. *Only few forms of dance of India and also of the west were considered for the sake of understanding the dance movement patterns, restrictions, difficulties, rigors of dance, but most of the dances considered for study were of dynamic and percussive in nature.*
8. *Only general trends in fitness culture was considered for the study with special emphasis to the Bollywood dance style.*

d. *Objective study d]\eliminations: (for experimental study to know the effect of specific physical exercise protocol on the performance variables of selected dance forms dancers)*

5. *Age rage of the dancers was 18 to 25 years.*
6. *Only Bharatanatyam, Kuchipudi and Bollywood dance forms were compared along with a control group.*

7. *Each dance group consisted of only 12 dancers.*
8. *All the dancers of the experimentation were from Hyderabad city only.*

Limitations for the study:

Limitations for the present study were also identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

c. *Subjective study limitations:*

3. *Historical edifices of this study may not symbolize and represent the global scenario of dance during the ancient and modern cultures.*

4. *Only few interview and questionnaire circulations through mail may not be representative of the opinion of the whole community of dancers, writers and critics of dance and dance training.*

d. *Objective study limitations:*

5. *The number of subjects in each group and also the age range being large may not significantly influence the effect of experimental variable i.e. physical exercise training on the dependent variables i.e. on the dance performance variables.*

6. *Nutritional and other lifestyle routines of the subjects or dancers was not monitored and may show some effect on the dependent variables of the study.*

7. *Social and financial backgrounds of the subjects or dancers were not taken into account during the intervention due to dearth of availability of dancers and this might show some impact on the results of the dependent variables of the study.*
8. *Since, the control group contained dancers of the three selected forms and they may not be matching in terms of performances and other physical factors with their respective dance form groups of the study and might show some effect on the results of the study.*

Inclusion criteria for the study:

Inclusion criteria for the present study were identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

c. *Subjective study inclusion criteria:*

4. *Only those historical edifices and literature sources which are credible and widely accepted were only consulted and included for the study to portray the historical tenets of dance ethos of both Indian classical, modern and contemporary dances.*
5. *Those interviews and questionnaires which were answered with a credential literature support was only included for analysis.*

6. *The concepts of movement science were taken only when the credential and authentic works are already recorded in accredited journals and literature sources.*

d. *Objective study inclusion criteria:*

4. *Only those subjects who had understood the whole concept of the experimental research as a sub topic of the whole research were only included.*
5. *Only those subjects who were regular for the exercise protocol only were finally included for the analysis.*
6. *In the control group, four each from three selected forms of dance were included.*

Exclusion criteria for the study:

Exclusion criteria for the present study were identified in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

c. *Subjective study exclusion criteria:*

3. *Studies and opinions which are opinionated, dogmatic and with concealed assertiveness on the issues of dance and dance fitness are specifically avoided.*

4. *Studies and books which reflected tenets of dance fitness without significant and sufficient rigorous scientific investigation.*

d. *<u>Objective study exclusion criteria:</u>*

4. *Those who are under regular physical training apart from their regular dance practice were not included in the study.*
5. *Those who are not able to understand the physical exercise science were also not included after conducting an orientation workshop to the prospective subjects at the initiation of the study.*
6. *Those who are on some chronic disorders and are on medicines for chronic time period were also not included into the study.*

<u>Hypotheses for the study:</u>

Hypotheses for the present study were identified and included at the initiation of the study to test in two perspectives. One in the perspective of subjective study on dance and fitness and another on the perspective of Objective effect of fitness training or dance training on the dance fitness and dance performances.

<u>Subjective hypotheses:</u> The following subjective hypotheses for the study were initiated at the beginning of the study to test, analyse and to discuss on the results basing on the hypotheses.

5. *Hypothesised that the dance has been an integral part of the fitness culture revolution both in India and across globe.*

6. *Hypothesised that the dance has been a medium of developing and maintaining aesthetic body culture.*
7. *Hypothesised that the dance training and dance performances have become inseparable part of human endeavor for health and wellness.*
8. *Hypothesised that the dance with its inherent ability of motivating people for physical activity became a very leading and effective form of physical training for fitness and health enhancement.*

<u>Objective hypotheses:</u> The following Objective hypotheses for the study were initiated at the beginning of the study to test, analyse and to discuss on the results basing on the hypotheses.

7. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the complete body involvement and its subsets of the three dance groups of the study.*
8. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the integration of the limbs of the body and its subsets of the three dance groups of the study.*
9. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the lower and upper limb connection and its subsets of the three dance groups of the study.*

10. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the gross motor movement skills and its subsets of the three dance groups of the study.*
11. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the expression integration and its subsets of the three dance groups of the study.*
12. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive impact on the overall dance performance levels of the selected three dance groups of the study.*

Statistical tools used for the study:

The pre-test and post-test values of the dance performances of the four groups were analysed with the help of Analysis of Covariance (ANCOVA) and further with the Scheffe's post hoc tests for obtaining results of the study and to make further discussion with respect to the results of the study basing on the statistical analysis.

Level of significance:

The level of significance used for the experimental verification was 0.05.

CHAPTER IV

ANALYSIS, DISCUSSION ON RESULTS AND HYPOTHESES

This chapter contains the discussion part of the thesis on the results obtained through the analysis of literature, tools adopted and the statistics applied. Basing on the results obtained the discussion on hypotheses also is projected in this chapter. Logical discussion and reasoning for the obtained results may also be defended through scientific studies already concluded and the opinions of the experts in the field of dance. Basing on the results and the acceptance or rejection of hypotheses of this study, logical conclusions will be derived and is incorporated in the last chapter of the thesis. Basing on the hypotheses proposed at the initiation of the research study, the discussion part is presented. For the present study there were two sets of hypotheses were proposed at the beginning of the study, categorised into subjective hypotheses and objective hypotheses. Subjective hypotheses were proposed to defend theoretically through the discussion, presentation and validation through evidences. Evidences may be through the published articles, answers through the questionnaires etc. The objective hypotheses were proposed keeping in view of the small experiment conducted to find out whether the physical exercise training would show any impact on the dance performances of dancers of few selected forms of India.

Hence, the discussion will be presented vividly first on the objective hypotheses and their variables. With respect to the subjective hypotheses the

discussion part will contain the narrative and validation under the section discussion on hypotheses directly.

Analysis on results and discussion on results of experimental component of the study

An experiment was conducted on a pilot mode to verify the effectiveness of a protocol of exercises on the dance performances of different types of dancers of the University of Hyderabad dance department. This particular study was aimed to make a preliminary investigation to know the possible effects on different components of dancers, the components which may influence significantly on the total dance performances of the various dancers. As per the movement science, which explains the basis of different physical movements there are several factors that may influence different biological areas of the body and may show significant influence on the movement maturity and gracefulness. Graceful and rhythmic physical movements need to be monitored in terms of just not in physical sense, but should be examined from the very core areas of neuromuscular transmissions and their influencing effects. Especially the classical, modern and neomodern dances are all have their own respective speciality movements that need excellent monitoring from the areas of central nervous system, peripheral nervous system and also from several movement and other receptors which are all responsible in unison for producing an excellent, rhythmic and flowing movements that would made extraordinary sense. Very similar to the complex sports movements, the movements in dance are also highly complex.

They not only require physical coordination but also expression coordination many a time to make complete sense and to convey the meaning and apt rasa to the spectators. Though it may be difficult to ascertain the integral components of these complex movements that might make the movements as complex to see and the mechanisms dwelling latently behind these complex movements are difficult to ascertain too. Kinesiological, Biomechanical and physiological endeavours of sports sciences and movement sciences made it possible to locate many and most of these important components that are responsible for these complex movements, whether they be of dancing or sports. In the same manner, there were some dance researchers especially certain western dance researchers did some meticulous and credible research efforts to identify different components that may be responsible for these complex dance movements. In fact, indirectly if an individual shows significantly higher scores in these components of dance movement fitness, such individual may be expected to perform better dance movements when compared to those who could not score comparable in these components. It is essential to identify these different responsible components and also to identify the scientific and biological processes behind each of this components to understand with credulous thought process.

Keeping in view of the perspectives and the research outcomes of different dance researchers, the scholar has identified with the help of sports scientists, movement scientists, the following different components for contribution to high level dance performances. There are five major components identified to be tested with different subsets of components as indicated in the table below.

S. No.	Name of the Component	Name of the subset component
1	Complete body involvement	Axial control
		Locomotor status
		Energy Maintenance
2	Integration of limbs of the body	Core support
		Spinal Involvement
		Integration of segments during dance
3	Coupling and Coordination of Lower and upper limbs	Lower limb connectivity to overall Movement
		Upper limb connectivity to Overall movement
4	Gross motor movement skills	Agility
		Balance
		Speed dynamics
5	Expression integration	Expression quality
		Connectedness of expression with music
		Connectedness of expression to flow

Though each of the five major components mentioned above would contribute for the higher order performances in dance. The effort here was only to explain the external factors that are responsible for the dance performances without much stress on the intrinsic factors like biological foundations of dance performances. But, the enough explanation is also given to bring optimum understanding on the biological foundations of dance performances in a nutshell without much emphasis on the core aspects of biological interactions of different areas of the body.

The capsule of experimentation was meant to test the effectiveness of certain protocols of physical exercises on the above five components and also on the subcomponents of the dance performances of the selected dance style dancers of the University of Hyderabad. As explained, physical exercise may lead to several changes in the bio environment of the individual leading to impacting transformations in the physical abilities. Physical exercise training should not be viewed just as external, but in fact foster for changes in biodynamics through the actions of mobilisation of cytokines which can bring extensive cross talk among tissues leading to temporary to permanent changes.

As already mentioned in the methodology of the experimental project, there may be certain limitations like convenient inclusion of the subjects keeping in view of the low number of population available in University of Hyderabad. All those who are willing to join were willingly included into the study with certain limitations. Twelve dance students were included for each group of dance styles included for the study viz

Bharatanatyam, Kuchipudi, Bollywood style dance and control group. A special protocol of physical exercises consisting of warming up, stretching, light plyometrics, running drills, floor resistance exercises etc was given as a training protocol for three months for the three experimental groups and the control group was asked to stay away from these exercises. Pre experiment (pre-test) and Post experiment (post-test) data of the five major components with their concerned subcomponents were measured with the help of senior research scholars and faculty of the department. The detailed methodology was included in the experimental methodology chapter which was included in the thesis separately with proper explanation for the protocol of the study. The detailed analysis of the data measured for all the five components and their subcomponents are given in detail.

Analysis on the component 'Complete Body Involvement':

There are three sub components or subsets in this component. They are Axial control, Locomotor status and Energy maintenance.

Subset: Axial control

This is on of the essential ingredients of the elite dance performances for dancers of any type, more specifically with those dancers who involve more in such movements involving gyrations and movements involving the help and control from the axial parts of the body mainly the core areas of the body. 'Axis' in the contemplation of the subject matter of Kinesiology or movement science, refers to the point or imaginary line by which a particular movement occurs in any particular plane.

A plane is an imaginary path of the movement that is possible with an opposite axis as the control point or imaginary line. Though there is no such imaginary line in the body of an individual, the core area of the individual serves as the area of axis and movement takes place with a stable axis as the point of rotation or origin of movement. Though there are three identified planes exist in the body of a dancer, like frontal, sagittal and transverse, the movement may occur in any one or in combination of these planes with related axis component. When the movement occurs in anterior posterior axis, the movement is seen in the frontal plane and in complex movements of dance, the movement may occur in combination and the dancer should have the ability to foresee and adjust as per the balance requirement and fulfilment of the dance movement as anticipated.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. I, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 1. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.30	3	0.10	1.06	0.3753
remainder	4.06	43	0.09		

Analysis of Covariance as indicated in table 2, indicated that the three dance groups of the experimentation were significantly different from the control group due

to the effect of the physical exercise protocol training, as the obtained F value ie 4.40 is significant at the P of 0.0087.

***Table 2. Analysis of Covariance for* Axial control**

Source	SS	df	MS	F	P
adjusted means	1.34	3	0.45	4.40*	0.0087
adjusted error	4.36	43	0.10		
adjusted total	5.70	46			

The comparison of mean values of the pre test and the post test for the three groups of the study indicated that Bharatanatyam group showed higher mean value ie 6.38 in terms of the axial control, followed by Kuchipudi group with 6.36, Bolly dance group with 6.25 and control group with 5.96. This enables to understand that the three groups of the study are significantly highly in the mean value of the axial control when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source

***Table 3. Mean values for* Axial control**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.69	6.23	6.38
Kuchi	6.15	6.54	6.36
Bolly	5.87	6.23	6.25
Cont	5.89	5.96	5.96

of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 4.

Figure I. ***pre, post and adjusted post-test values for*** **Axial control**

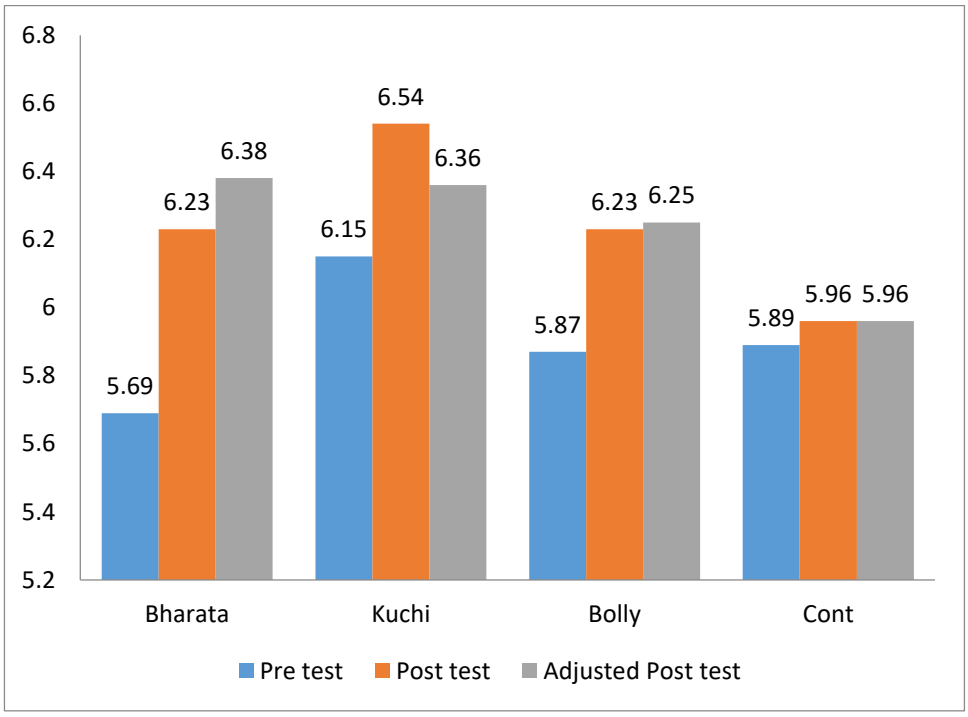


Table 4. Scheffe's Post hoc individual comparison test (Scheffe's CD = 0.4)

Means		6.36	6.25	5.96
	6.38	0.02	0.13	0.42*
	6.36		0.11	0.4*
	6.25			0.29

significant at 0.05

Scheffe's post hoc test as indicated in table 4 revealed that there was no significant difference between Bharatanatyam and Kuchipudi groups (0.02),

Bharatanatyam and Bollywood groups (0.13), Kuchipudi and Bollywood groups (0.11) and Bollywood and Control groups (0.29) due to the experimental physical training in their axial control, but there was significant difference between the Bharatanatyam and Control groups (0.42) and Kuchipudi and control groups (0.40). This indicates clearly that the Bharatanatyam and Kuchipudi groups could experience significant improvement in their axial control of dance movements due to the physical fitness training protocol of the experimentation.

Subset: Locomotor status

This is another very important subset or component of the complete body movement of the dancers. This particular component makes major part of the dance movements of a dancer of any type. Locomotion as per the movement science indicates the complete body movement of the person from one place to another place and this movement may consist of several actions like gyrations, jumps, twists, rolls, lunges, steps or combination of such physical movement skills. Though non locomotor movements of the dancer also makes significant part in the classical dances and also in modern dances, the non-locomotor aspect is not included as a component of complete body movement. Graceful transfer of body from the place of source to the place of intention is highly essential to make the dance to look and appear with flow and rhythm. In fact, the flow and rhythm are necessary accompaniments during the locomotor movements for a dancer to make the dancing more sensible, appreciable and meaningful.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 5, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 5. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.54	3	0.18	1.25	0.3042
remainder	6.26	43	0.15		

Analysis of Covariance as indicated in table 6, indicated that the three dance groups of the experimentation were not significantly different from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 1.08 was not significant at the P of 0.3673.

Table 6. Analysis of Covariance for: **Locomotors status**

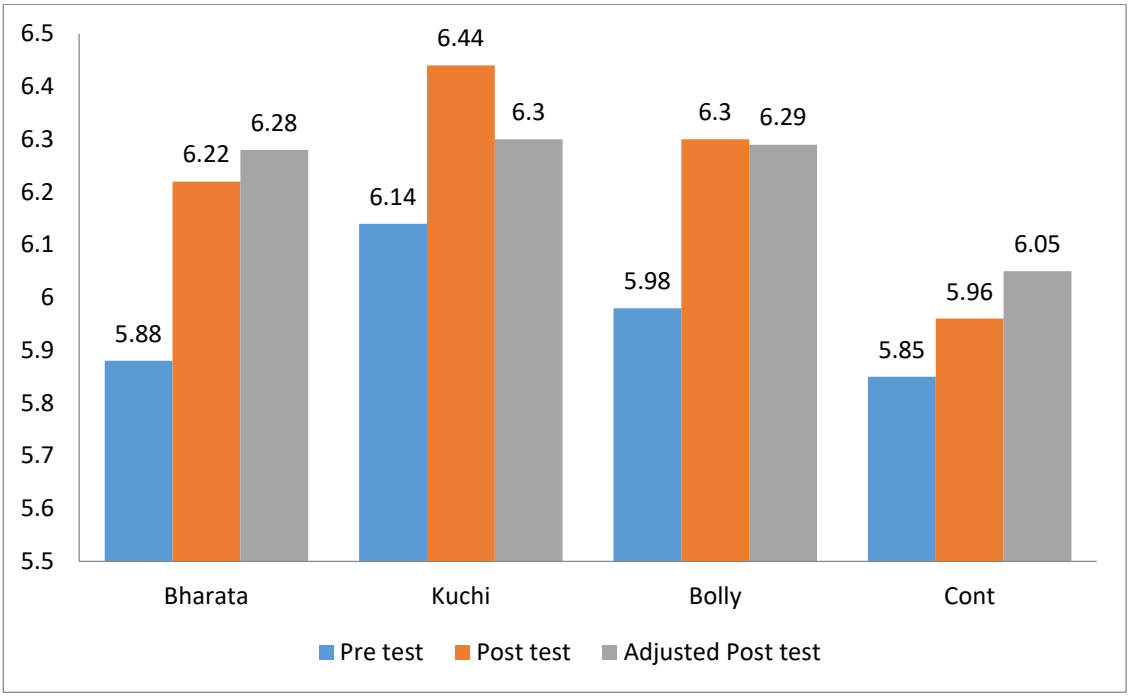
Source	SS	df	MS	F	P
adjusted means	0.51	3	0.17	1.08	0.3673
adjusted error	6.80	43	0.16		
adjusted total	7.31	46			

Table 7. Mean values for Resting pulse rate

Group/mean	***Pre test***	***Post test***	***Adjusted Post test***
Bharata	5.88	6.22	6.28
Kuchi	6.14	6.44	6.30

Bolly	5.98	6.30	6.29
Cont	5.85	5.96	6.05

Figure 2. ***Pre, post and adjusted post-test values for*** **Locomotor status**



Descriptive analysis by means of the locomotor status as indicated in table 7 depicts that all the three groups of the dancers of the study experienced gain in their locomotor status post the physical exercise of the experimentation. An in-depth examination of the table revealed that the Bharatanatyam group experienced more numerical gain in the mean value of the locomotor status than the other two dance groups of the study. Since, the analysis of covariance indicated no significant difference among the groups of the study, the scheffe's post hoc test was not done.

Subset "Energy maintenance*:*

This is another sub set or sub component of the component "Total Body involvement". This is another very important variable that would help the dancers to be more graceful and spectacular in all the elements of the dance. The elements of the dance are several like velocity of dance, expressions during the dance, intensity of the dance, force element of the dance, time element of the dance etc. Constantly being energetic during the entire dance performance is highly essential to maintain all the elements of the dance to make the dance performance very fruitful and authentic for dissemination of 'rasa' element to the spectators and to the dancers themselves. Fatigue in any form, whether it be physical, mental or emotional may lead to severe distraction to energy flow leading to sudden or unforeseen deterioration of energy flow.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 8, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 8. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.97	3	0.32	2.74	0.0549
remainder	5.08	43	0.12		

***Table 9. Analysis of Covariance for* Energy maintenance**

Source	SS	df	MS	F	P
adjusted means	1.43	3	0.48	3.39*	0.0264
adjusted error	6.05	43	0.14		
adjusted total	7.48	46			

Analysis of Covariance as indicated in table 9, indicated that the three dance groups of the experimentation were significantly different from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 3.39 is significant at the P of 0.0264.

***Table 10. Mean values for* Energy maintenance**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.28	5.76	5.66
Kuchi	5.33	5.87	5.73
Bolly	5.10	5.54	5.59
Cont	4.93	5.08	5.27

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.73 in terms of the axial control, followed by Bharatanatyam group with 5.66, Bolly dance group with 5.59 and control group with 5.27. This enables to understand that the three groups of the study are significantly high in the mean value of the energy maintenance when compared to the control group of the study, but to understand whether this numerical

difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 11.

Figure 3. ***Pre, post and adjusted post-test values for*** **Energy maintenance**

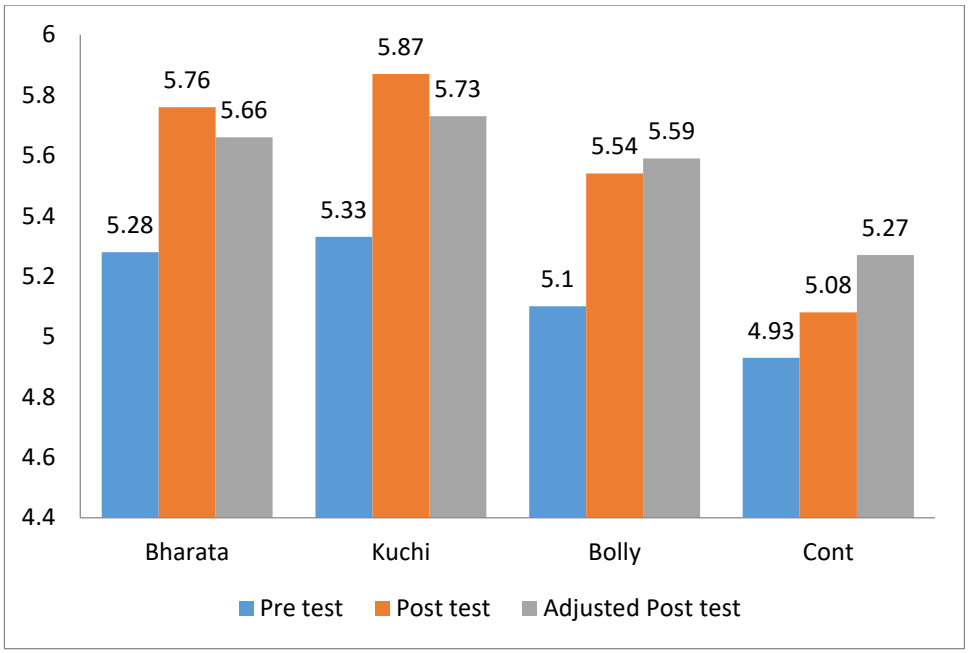


Figure 3

Table 11. Scheffe's Post hoc individual comparison test for **Energy maintenance** ***(Scheffe's CD = 0.43)***

Means		5.73	5.59	5.27
	5.66	-0.07	0.07	0.39
	5.73		0.14	0.46*
	5.59			0.32

significant at 0.05

Scheffe's post hoc test as indicated in table 11 revealed that there was no significant difference between Bharatanatyam and Kuchipudi groups (0.07), Bharatanatyam and Bollywood groups (0.07), Kuchipudi and Bollywood groups (0.14) and Bollywood and Control groups (0.32) due to the experimental physical training in their axial control, but there was significant difference between the Kuchipudi and control groups (0.46). This indicates clearly that the Kuchipudi group alone could experience significant improvement in their energy maintenance variable of dance movements due to the physical fitness training protocol of the experimentation.

Component: Integration of limbs of the body

This particular component is very specific for the performance of dance, specially to make the dance more appeasing and indulging for spectators. This makes the dance movements appear very attractive and meaningful too for some dances, especially for dances which recognised the gestures as symbols of dialogue and speech, dances like Bharatanatyam, Kuchipudi etc. But, movement science and the studies in Kinesiology confirm that integration of the limbs of the body during physical movement needs to be supported from core strength of the dancer and how the dancer involves the spine of the body in execution of the movement. Higher the core support and spinal involvement, the dancer can be able to achieve better coordination of the limbs o the body during the complex dance movements. Very meaningful integration and coupling of the limbs of the body is highly essential, and in this area most of the

beginners make several uncomfortable faults leading to several pitfalls in conveying the meaning of the dance protocols.

Subset: Core support*: Analysis of Covariance*

This is an essential element in achieving the movements of the limbs with ease and dexterity. Electromyographical studies in movement science indicate that though the movements appear to happen with limbs while the limbs are moved, the support comes from the contraction of several abdominal and spinal muscles which are considered as core muscles of the body. The scientific fact is the strong core leads to the strong and powerful limb movements. Along with the specific muscle strength and other physical elements, the dancer needs high levels of core strength to execute the limb movements with comfort and luxury.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 12, that the groups of the dancers are initially equated in the variable of core support, as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 12. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.06	3	0.02	0.21	0.8857
remainder	4.22	43	0.10		

***Table 13. Analysis of Covariance for* Core support**

Source	SS	df	MS	F	P
adjusted means	0.15	3	0.05	0.52	0.6729
adjusted error	4.28	43	0.10		
adjusted total	4.43	46			

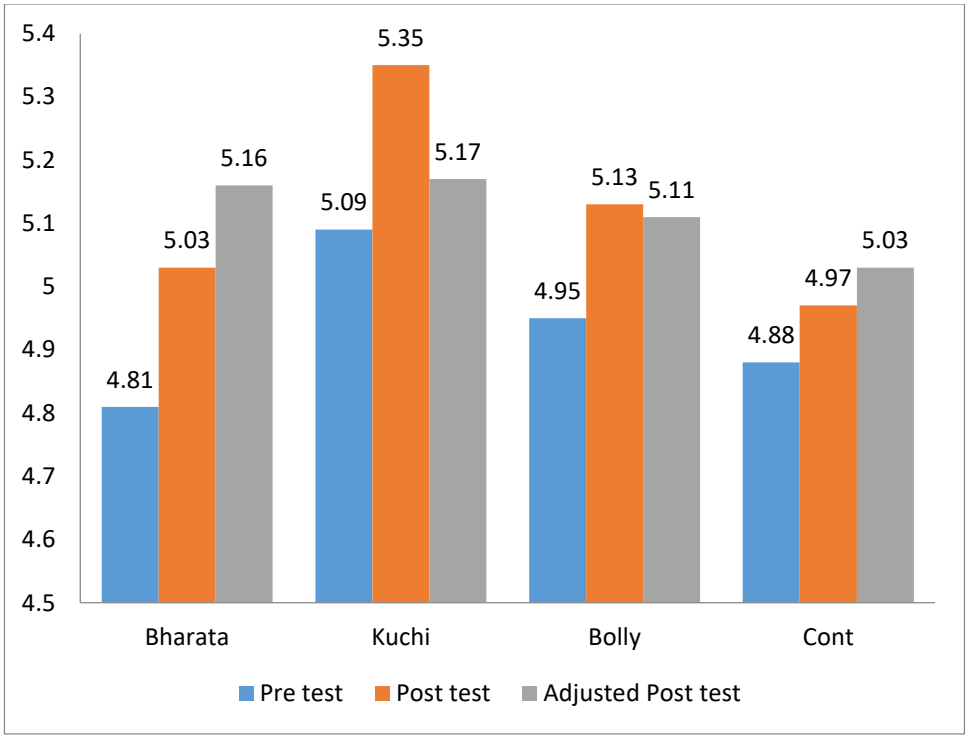
Analysis of Covariance as indicated in table 13, indicated that the three dance groups of the experimentation were not significantly different in the core support variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 0.52 is not significant at the P of 0.0264.

Descriptive analysis through mean values of the core support of the groups, as indicated in table 14, elicits that kuchipudi group had higher core support with a post-test mean of 5.17, followed by Bharatanatyam group with 5.16 and Bollywood dance group with 5.11. Though all the three groups showed numerically significant difference when compared to the control group, these differences were not considered as statistically significant as per the covariance test.

***Table 14. Mean values for* Core support**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	4.81	5.03	5.16
Kuchi	5.09	5.35	5.17
Bolly	4.95	5.13	5.11
Cont	4.88	4.97	5.03

Figure 4. *Pre, post and adjusted post-test values for* Core support



Since, the groups were not significantly different as per the covariance analysis, Scheffe's post hoc analysis was not conducted.

Spinal involvement*: Analysis of Covariance*

This element may be understood as spinal articulation during dancing and how the spine of the dancer is involved during the complex dance movements. Spine is one of the very flexible anatomical areas of the body and also very essential area of the body in terms of the total movement of the dancer. Apart from receiving strength and power from this area of the body, the dancer can also use this area of the body to create very rhythmic and articulating movements. Since, this area is most flexible and can be used by the dancer in different direction simultaneously, the beauty of the dance movements grows significantly if the dancer is able to articulate the spine of the body to suit the language of the dance. The anatomy of the spine allows the dancer to twist,

to bend in different directions simultaneously. An adept dancer may be able to use the cervical, thoracic, lumbar and sacral portions of the spine to suit to the movements of the dance performance. These four portions of the spinal area may be used differently to produce very complex movements and this may be termed as the spinal involvement of the dancer. A very dextrous dancer can bring back the lumbar spine beyond the frontal line, while at the same time bringing the thoracic spine forward. Even forward and lateral movements are also possible by very expert dancers making the movements very attractive, complex and flowy. But, this kind of complex movements are extremely difficult to attain and needs a lot of practice and also neuromuscular facilitation.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 15, that the groups of the dancers are initially equated in the variable of spinal involvement, as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 15. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.25	3	0.08	1.03	0.3893
remainder	3.43	43	0.08		

***Table 16. Analysis of Covariance for* Spinal involvement**

Source	SS	df	MS	F	P

adjusted means	0.29	3	0.10	1.13	0.3481
adjusted error	3.68	43	0.09		
adjusted total	3.97	46			

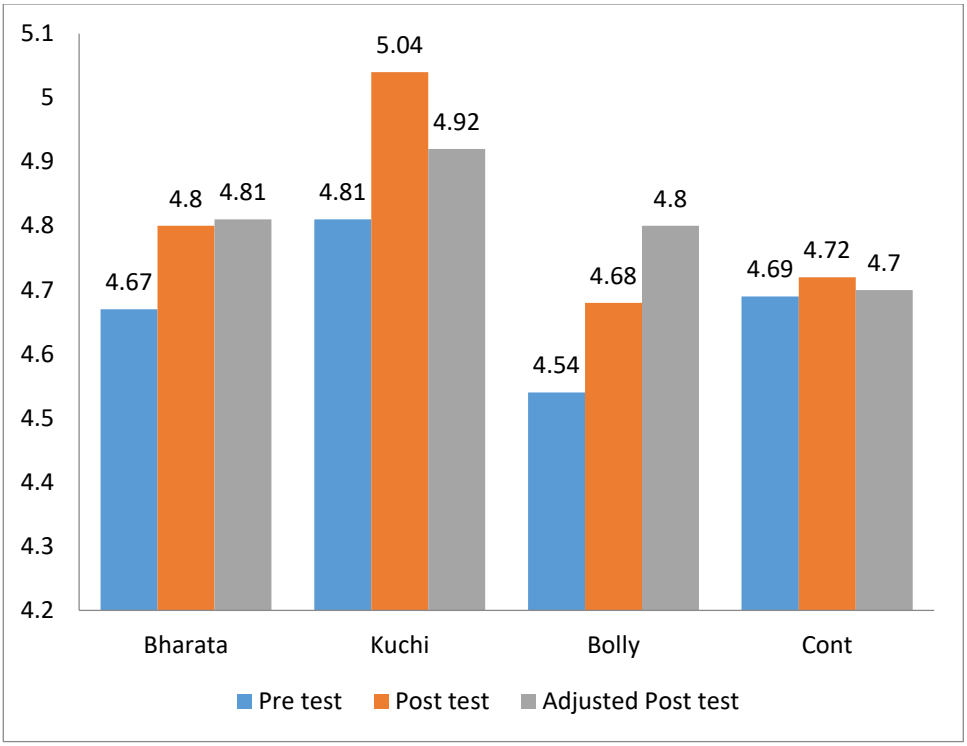
Analysis of Covariance as indicated in table 16, indicated that the three dance groups of the experimentation were not significantly different in the spinal involvement variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 1.13 is not significant at the P of 0.3481.

Descriptive analysis through mean values of the spinal involvement of the groups, as indicated in table 17, elicits that kuchipudi group had higher spinal involvement with a post-test mean of 4.92, followed by Bharatanatyam group with 4.81 and Bollywood dance group with 4.80. Though all the three groups showed numerically significant difference when compared to the control group, these differences were not considered as statistically significant as per the covariance test.

***Table 17. Mean values for* Spinal involvement**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	4.67	4.80	4.81
Kuchi	4.81	5.04	4.92
Bolly	4.54	4.68	4.80
Cont	4.69	4.72	4.70

Figure 5. ***Pre, post and adjusted post-test values for* Spinal involvement**



Since, the groups were not significantly different as per the covariance analysis, Scheffe's post hoc analysis was not conducted for spinal involvement variable.

Integration of segments during dance*: Analysis of Covariance*

Integration of the body segments may be considered as the primary requisite for showcasing the complex movements by the dancer to the visibility. The capable dancer can integrate the different body segments to make the dance very meaningful in tune to the flow of the language of the dance both physically and emotionally. In fact this skill is considered as a complex motor skill by the kinesiologists or movement scientists, since it not only require physical awareness and also the neuropsychological awareness. Movement scientists are attributing this skill as some thing not volitional but involuntary once, the movements are mastered through constant practice. Sense of

kinesthesis plays vital role in achieving this complex skill and this requires not simply the physical practice but also maturity of both the afferent and efferent neural receptors of the body. Higher order neuronal areas of the brain like motor cortex, supplemental motor cortex, motor homunculus, cerebellum, basal ganglia etc are all involved in a very complex manner to make movements of the dancer from cognitive to associative to autonomous.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 18, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 18. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.25	3	0.08	1.69	0.1834
remainder	2.09	43	0.05		

Analysis of Covariance as indicated in table 19, indicated that the three dance groups of the experimentation were significantly different in the integration of segments variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 8.35 is significant at the P of 0.0002.

Table 19. Analysis of Covariance for **Integration of segments during dance**

Source	SS	df	MS	F	P
adjusted means	1.36	3	0.45	8.35	0.0002

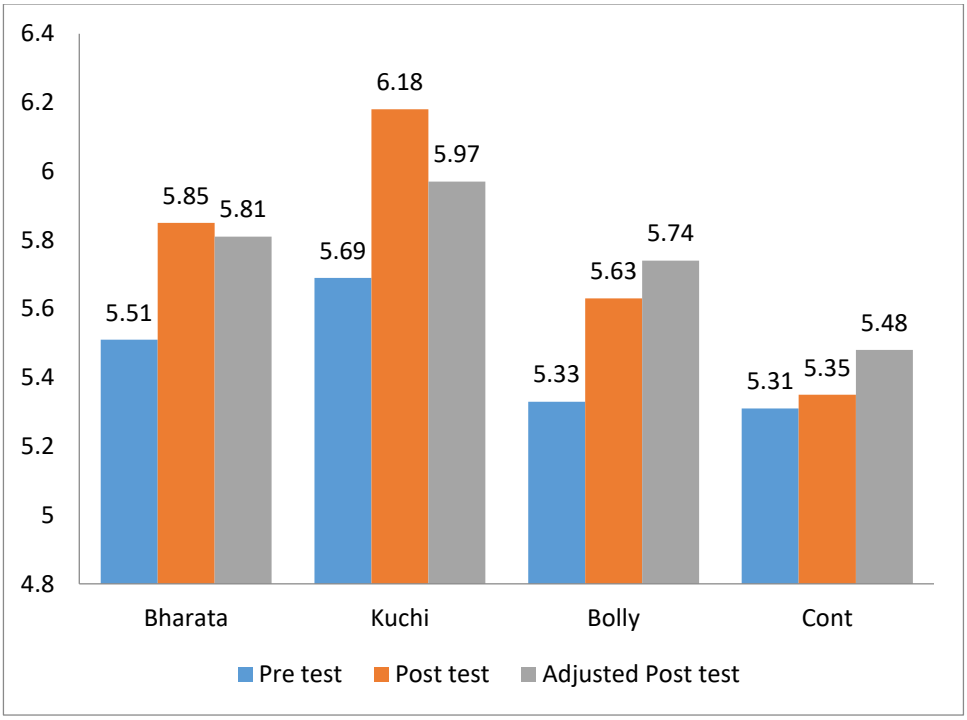
adjusted error	2.34	43	0.05
adjusted total	3.70	46	

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.97

***Table 20. Mean values for* Integration of segments during dance**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.51	5.85	5.81
Kuchi	5.69	6.18	5.97
Bolly	5.33	5.63	5.74
Cont	5.31	5.35	5.48

Figure 6. ***Pre, post and adjusted post-test values for* Integration of segments during dance**



in terms of the integration of segments, followed by Bharatanatyam group with 5.81, Bolly dance group with 5.74 and control group with 5.48. This enables to understand that the three groups of the study are significantly high in the mean value of the integration of limbs when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 21.

Table 21. Scheffe's post hoc individual comparison test

(CD = 0.40)

Means	5.97	5.74	5.48
5.81	-0.16	0.07	0.33
5.97		0.23	0.49*

5.74	0.26

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 21 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.16), Bharatanatyam and Bolly groups (0.07), Kuchipudi and Bolly dance groups (0.23) and Bolly and Control groups (0.26). But, the post hoc analysis indicated that there was significant difference between the Kuchipudi and Control Groups (0.49) indicating that the Kuchipudi groups could experience the significant improvement in their ability of integration of limbs when compared to the other two groups of the dancers of the study.

Component: Lower and upper limb coupling and coordination

The component of lower and upper limb coupling and coordination is very vital in terms of producing well-coordinated and complex movements in dancing. Most of the dances comprise of complex movements, which needs exorbitant amount of neuromuscular coordination and also the other perceptual elements to produce graceful movements with ease and dexterity. Apart from being the sources of complex movements, some of the Indian classical dances also require such movements to symbolise to manifest excellent and meaningful communication to the spectators by these complex movement gestures. It is highly essential to be very precise and accurate in bringing the coordination between the different limbs of the body as per the sequence of the dance, lest the whole dance appears very hazy, ill defined and awkward. As per the movement science or kinesiology, this particular variable is a

complex physical variable or a motor quality of an individual requires several neuro muscular apparatuses to operate simultaneously. Both afferent and efferent neuronal systems should be very matured and strong enough to make the coupling of limbs more accurate and precise. Core areas of movement science, viewing from the angle of neuro physiology, indicates that this component is highly complex in its mechanism, which may even require the genetic predisposition for maturation of these neuronal apparatuses.

Subset: Lower limb connectivity to overall movement

Most of the dances whether they be Indian or foreign, have many meanings to convey during the process of dancing. Though some Indian classical dances are more specific in terms of manifesting complex unspoken dialogues during the dance movements and this is achieved only through highly graceful and complex movements. Even when the need of conveying meaningful expressions are not essential ingredients of a dance, it would be highly ideal to have well structured and performed dance movements to engage the spectators on awe and astonishment. The lower limb connectivity to the overall body movement makes it as more meaningful and also brings more sense attached for such dance movements. The lower limbs being the body components which engage the dancers to engage in both vertical and horizontal mobility, the control and coordination ability of the lower limbs make the dancers movements more swifter and highly engaging to spectators.

Analysis of Covariance

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 22, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 22. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.23	3	0.08	1.35	0.2712
remainder	2.47	43	0.06		

***Table 23. Analysis of Covariance for* Lower limb connectivity to overall movement**

Source	SS	df	MS	F	P
adjusted means	0.28	3	0.09	1.50	0.2293
adjusted error	2.70	43	0.06		
adjusted total	2.98	46			

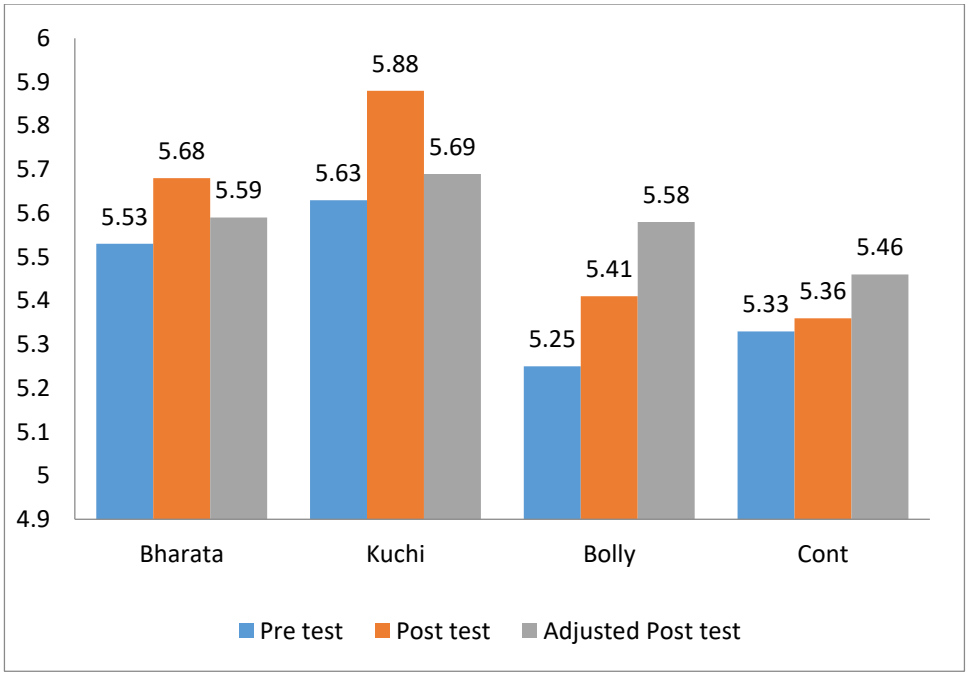
Analysis of Covariance as indicated in table 23, indicated that the three dance groups of the experimentation were not significantly different in the lower limb connectivity to overall movement variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value i.e. 1.50 was not significant at the P of 0.2293.

***Table 24. Mean values for* Lower limb connectivity to overall movement**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*

Bharata	5.53	5.68	5.59
Kuchi	5.63	5.88	5.69
Bolly	5.25	5.41	5.58
Cont	5.33	5.36	5.46

Figure 7. ***Pre, post and adjusted post-test values for*** **Lower limb connectivity to overall movement**



Descriptive analysis through mean values of the Lower limb connectivity to overall body movement of the groups, as indicated in table 24, elicits that kuchipudi group had higher post-test mean of 5.69, followed by Bharatanatyam group with 5.59 and Bollywood dance group with 5.58. Though all the three groups showed numerically significant difference when compared to the control group, these differences were not considered as statistically significant as per the covariance test. Since, there was no significant difference among the groups for the variable lower limb connectivity to

overall body movement due to the experimental physical activity protocol, the Scheffe's post hoc comparison test was not done to find out the source of the significant difference.

Upper limb connectivity to overall movement*:*

Upper limbs movement and their connectivity to the overall movement is another essential ingredient of graceful and expressive dance protocols. Especially the bilateral and ambidextrous movements are highly influential for making the dancer a highly credible and fruitful. Though it may be highly difficult to execute ambidextrous movements with precision and fluid, it is also not an impossible task with certain physical exercise protocols sufficiently early. Kinesiological studies clearly indicate that the upper limbs in order to get coordinated with two different movements for each in alignment to the total body movement is extremely complex and difficult to attain, but a very big prerequisite for making the dance more explosive, dynamic and expressive too. Constant cerebellar corrections and monitoring through the basal ganglia would help to make these complex movements as and when they are in deviation to the required quality and grace. There are several central movement pattern generators that are in the dorsal horns of the spinal cord are also responsible for these complex movements of dancers. At the same time there seems very logical and scientific correlation between these complex movements and the physical qualities like central fatigue, endurance, power and coordination.

Analysis of Covariance

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 25, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 25. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.12	3	0.04	0.94	0.4282
remainder	1.81	43	0.04		

***Table 26. Analysis of Covariance for* Upper limb connectivity to overall movement**

Source	SS	df	MS	F	P
adjusted means	0.46	3	0.15	3.40	0.0261
adjusted error	1.93	43	0.04		
adjusted total	2.38	46			

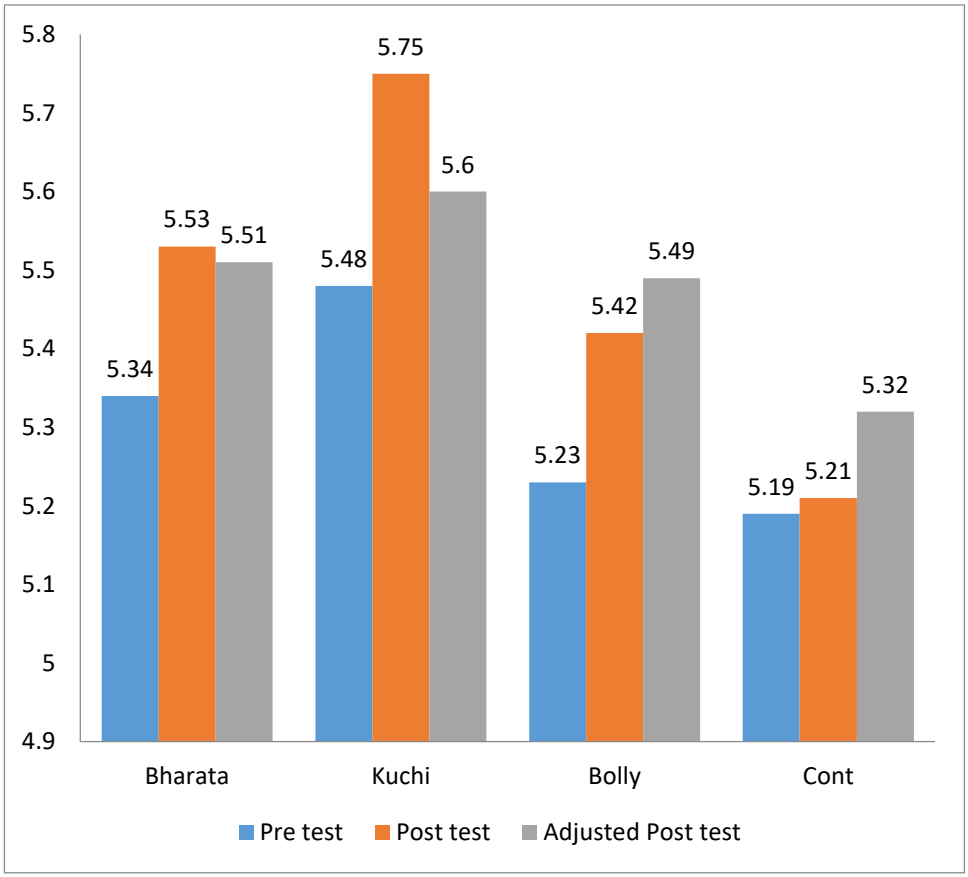
Analysis of Covariance as depicted in table 26, indicated that the three dance groups of the experimentation were significantly different in the upper limb connectivity to overall movement variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 3.40 is significant at the P of 0.0261.

***Table 27. Mean values for* Upper limb connectivity to overall movement**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.34	5.53	5.51

Kuchi	5.48	5.75	5.60
Bolly	5.23	5.42	5.49
Cont	5.19	5.21	5.32

Figure 8. ***Pre, post and adjusted post-test values for*** **Upper limb connectivity to overall movement**



The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.60 in terms of the Upper limb connectivity to overall movement, followed by Bharatanatyam group with 5.51, Bolly dance group with 5.49 and control group with

5.32. This enables to understand that the three groups of the study are significantly high in the mean value of the integration of limbs when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and to find out the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 28.

Table 28. Scheffe's post hoc individual comparison test
(CD = 0.22)

Means	5.6	5.49	5.32
5.51	-0.09	0.02	0.19
5.6		0.11	0.28*
5.49			0.17

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 28 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.09), Bharatanatyam and Bolly groups (0.02), Kuchipudi and Bolly dance groups (0.11) and Bolly and Control groups (0.17). But, the post hoc analysis indicated that there was significant difference between the Kuchipudi and Control Groups (0.28) indicating that the Kuchipudi group could experience the significant improvement in their ability of Upper limb connectivity to overall movement when compared to the other two groups of the dancers of the study.

Component: Gross motor movement skills

Motor skills or motor movement skills are different movements that are done with the help of the motor physiology of the nervous system and may be classified as gross motor skills and fine motor skills. Gross motor skills or gross motor movements may be such movements which are executed with movements in the major parts of the body like upper limbs, lower limbs, torso, head etc, mainly involving the major muscle groups and the major perceptual apparatuses of the body. Sense of kinesthesis is highly necessary to execute these gross motor skills. Fine motor skills or fine motor movements are generally very sophisticated and complex movements that are seen at the sensitive level like gestures of the hands, eye movements in resonance to a rhythm or expectation. Gross motor skills or movements also take help from the motor cortex, premotor cortex and their connections to the various limbs that facilitate for these movements with the help of neuromuscular facilitation physiology. Measuring and evaluation of efficiency of the gross motor skills of an individual is quite difficult and hence the objective assessment of this may be done through measuring the components that are responsible for the expertise in gross motor skills or movements. They may be agility, balance, coordination, coupling, speed dynamics etc.

Subset: Agility*: Analysis of Covariance*

Agility is one of the very important motor skill components that would bring an individual ease in making twisting, halting, changing direction movements at ease with dexterity. Agility may be understood as the motor ability component that makes an individual to change the direction of the whole body or part/parts of the body at will

with maximum control to derive the intended movement. This is very complex motor component which require high assistance from the higher order motor areas of the brain and also peripheral neurons and receptors of the body and joints of the body. Constant reception, feedback and neuronal initiation from the peripheral receptors and the cerebellar apparatus, corrects the ongoing motor movements and initiates the desired motor movements. Higher levels of agility makes a dancer to be more agile in terms of bringing the movement changes very swiftly and accurately with lots of precision.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 29, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 29. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.16	3	0.05	1.18	0.3298
remainder	2.01	43	0.05		

***Table 30. Analysis of Covariance for* Agility**

Source	SS	df	MS	F	P
adjusted means	1.07	3	0.36	7.06	0.0006
adjusted error	2.17	43	0.05		
adjusted total	3.24	46			

Analysis of Covariance as indicated in table 30, indicated that the three dance groups of the experimentation were significantly different in the agility variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 7.06 is significant at the P of 0.0006.

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Bollywood dance group showed higher mean value ie 5.65 in terms of the agility, followed by Bharatanatyam group with 5.61, Kuchipudi dance group with 5.60 and control group with 5.28. This enables to understand that the three groups of the study are significantly high in the mean value of agility variable when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 32.

***Table 31. Mean values for* Agility**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.25	5.58	5.61
Kuchi	5.43	5.73	5.60
Bolly	5.21	5.59	5.65
Cont	5.23	5.23	5.28

Figure 9. *Pre, post and adjusted post-test values for* Agility

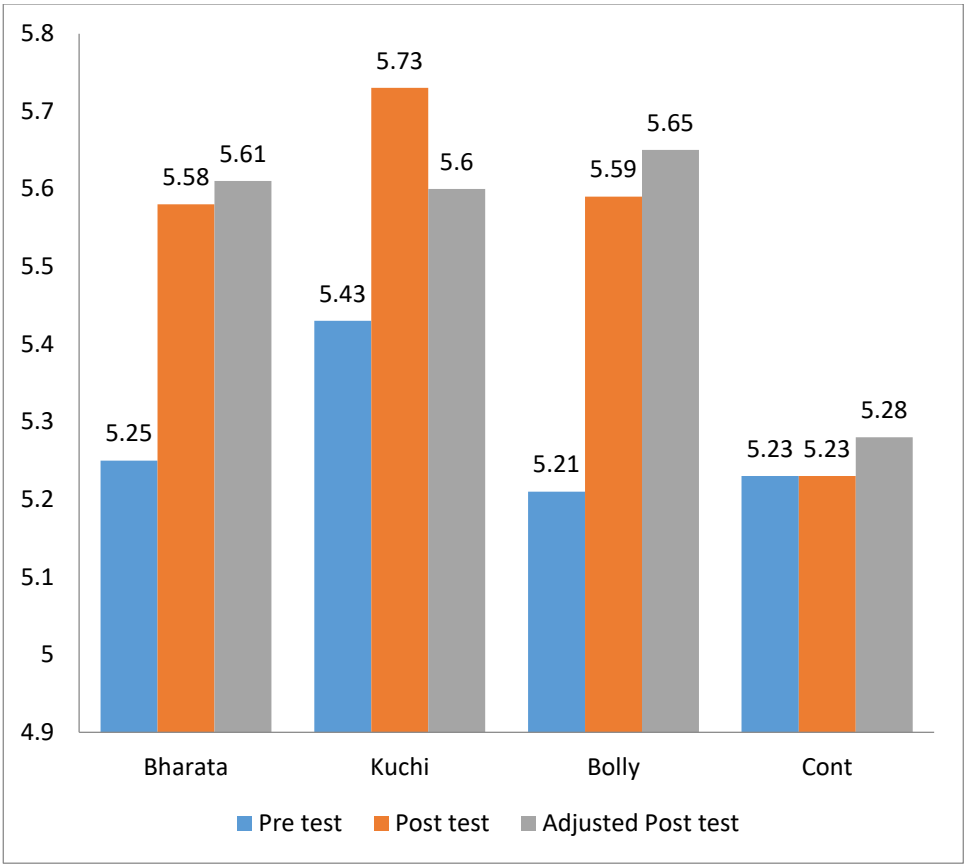


Table 32. Scheffe's post hoc individual comparison test

(CD = 0.32)

Means	5.6	5.65	5.28
5.61	0.01	-0.04	0.33*
5.6		-0.05	0.32*
5.65			0.37*

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 32 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.01), Bharatanatyam and Bolly groups (0.04), Kuchipudi and Bolly dance groups

(0.05). But, the post hoc analysis indicated that there was significant difference between the Bharatanatyam and control groups (0.33), Kuchipudi and Control Groups (0.32) and also between Bollywood dance and control groups (0.37) indicating that the all the three dance groups of the study could experience the significant improvement in their ability of agility.

Balance*: Analysis of Covariance*

Balance ability denotes the ability of an individual to be able to control the line of centre of gravity of the body to fall within the base and not to fall out of control. This is very important motor quality which makes individual to make complex physical movements leaning any side of the body while having contact with the ground but still to have control over the body without falling to ground. This particular motor component makes individual to be able move swiftly even on one foot without losing control over the ground and to produce excellent movements.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 33, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 33. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.05	3	0.02	0.26	0.856
remainder	2.56	43	0.06		

Table 34. Analysis of Covariance for **Balance**

Source	SS	df	MS	F	P
adjusted means	0.68	3	0.23	3.72	0.0182
adjusted error	2.60	43	0.06		
adjusted total	3.28	46			

Analysis of Covariance as indicated in table 34, indicated that the three dance groups of the experimentation were significantly different in the balance variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 3.72 is significant at the P of 0.0182.

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.77 in terms of the balance variable, followed by Bharatanatyam group with 5.70, Bolly dance group with 5.57 and control group with 5.43. This enables to understand that the three groups of the study are significantly high in the mean value of the balance when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the

Table 35. Mean values for **Balance**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.42	5.71	5.70
Kuchi	5.63	5.91	5.77
Bolly	5.36	5.55	5.57

Cont	5.18	5.30	5.43

source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 35.

Figure 10. ***Pre, post and adjusted post-test values for*** **Balance**

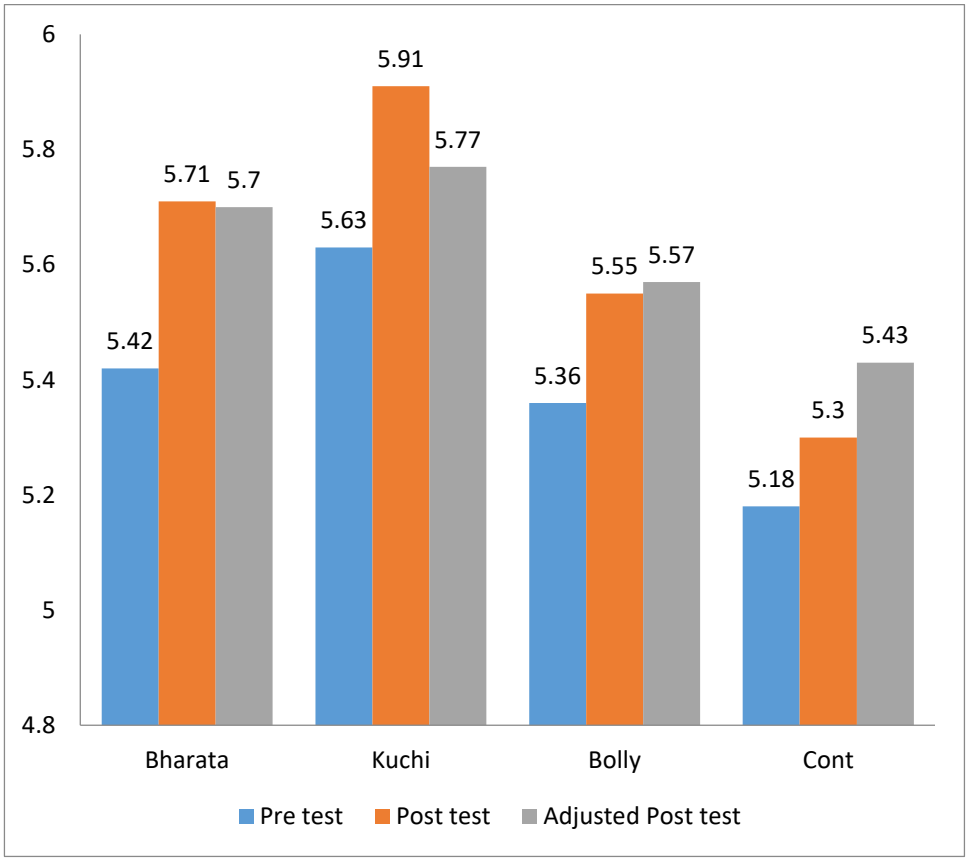


Table 36. Scheffe's post hoc individual comparison test

(CD = 0.29)

Means	5.77	5.57	5.43
5.7	-0.07	0.13	0.27
5.77		0.2	0.34*
5.57			0.14

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 36 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.07), Bharatanatyam and Bolly groups (0.13), Kuchipudi and Bolly dance groups (0.2) and Bolly and Control groups (0.14). But, the post hoc analysis indicated that there was significant difference between the Kuchipudi and Control Groups (0.34) indicating that the Kuchipudi group could experience the significant improvement in their balance ability when compared to the other two groups of the dancers of the study.

Speed dynamics*: Analysis of Covariance*

Among the several elements of dance space, speed dynamics plays very vital role in terms of movement speed variations during the dance performances. It is ideal for the dancer to be able to execute variations in speed as per the required dance space and tempo of the music that may be played to bring expression to dance. As per the variations required, speed of the dance need to be changed very accurately in sync to the meaning of the dance. But the change in the speed need to be conducted very smoothly and with swift transition, whether it is increase in speed of the dance movement or decrease in the speed of the dance movement. Though the factors like endurance, agility levels of an individual might influence the speed dynamics of the dancer, these fitness components may very well be controlled through regular practice.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 37, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 37. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.15	3	0.05	0.94	0.4302
remainder	2.25	43	0.05		

Analysis of Covariance as indicated in table 38, indicated that the three dance groups of the experimentation were significantly different in the speed dynamics variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 7.72 is significant at the P of 0.0003.

***Table 38. Analysis of Covariance for* Speed dynamics**

Source	SS	df	MS	F	P
adjusted means	1.29	3	0.43	7.72	0.0003
adjusted error	2.39	43	0.06		
adjusted total	3.68	46			

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.59 in terms of the speed dynamics variable, followed by Bollywood dance group with 5.52, Bharatanatyam dance group with 5.48 and control group with 5.12. This enables

to understand that the three groups of the study are significantly high in the mean value of the speed dynamics variable when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 40.

***Table 39. Mean values for* Speed dynamics**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.21	5.50	5.48
Kuchi	5.43	5.76	5.59
Bolly	5.15	5.50	5.52
Cont	4.93	4.94	5.12

Figure 11. ***Pre, post and adjusted post-test values for* Speed dynamics**

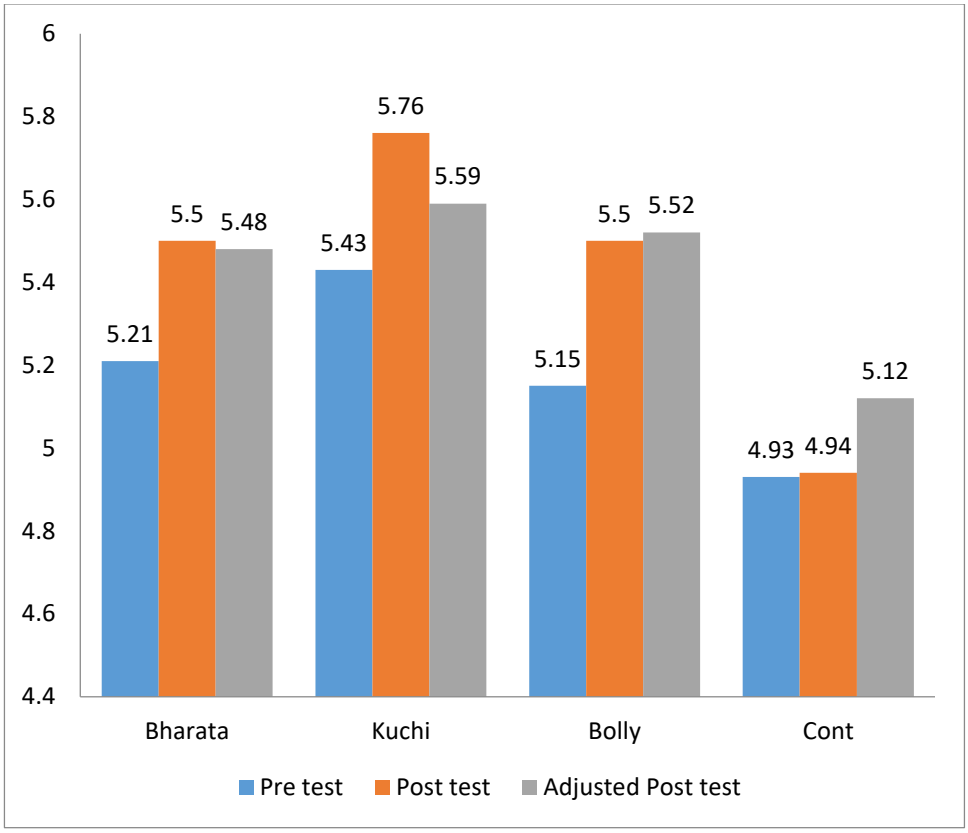


Table 40 : Scheffe's post hoc individual comparison test

(CD = 0.4)

Means	5.59	5.52	5.12
5.48	-0.11	-0.04	0.36
5.59		0.07	0.47*
5.52			0.4*

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 40 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.11), Bharatanatyam and Bolly groups (0.04), Kuchipudi and Bolly dance groups (0.07). But, the post hoc analysis indicated that there was significant difference

between the Kuchipudi and Control Groups (0.47) and also between Bolly wood dance and control groups (0.4) indicating that the Kuchipudi and Bollywood dance groups could experience the significant improvement in their ability of speed dynamics when compared to the other two groups of the dancers of the study.

Component: Expression integration

Expression to the latent meaning of the dance executed carries significant importance for the dance performances, to make the performance most interesting and to convey the intended rasa both to the dancer and to the spectators. In case of Indian classical dances, the expression aspect of the dance is very remarkable and powerful component of the dance to convey the intended meaning in appropriate manner. Many a time, the expressions may be very complex in nature indicating the simultaneous conveyance of an array of meanings that would carry and convey message to the spectators. Even the dancer may experience the required rasa when the dancer is able to make suitable expressions. The scientific domain of the exercise and movement science, indicates that integration of expression with the physical movements of the body is quite complex and requires additional coordination from the kinaesthetic apparatuses and also from the higher order brain compartments, which regulate the gross movements and finer physical movements. These fine motor movements required by dancer may be recognised as hand-eye coordination, eye-leg coordination, eye-torso coordination, facial muscles and eye coordination, facial muscles and limbs coordination etc. Though the above stated coordination abilities may be gross in appearance, the finer movements occur with eye, face and hand muscles to produce

finer motor tasks of the dancers. There must be highest degree of coordination and coupling among the fascial muscles, eye muscles, hand muscles to bring excellent efforts in dancing with fine motor tasks. Motor cortex, premotor cortex, cerebellum, basal ganglia, dorsal horn receptors, joint receptors and also the neurons that are interconnected with these apparatuses are involved in this regard. The latest research in neurophysiology, brings out the concept of Central pattern generators that are present in dorsal horns of the spine, which are responsible for unconscious and rhythmic movements may play significant role in the fine motor skills of dancers.

Subset: Expression quality *Analysis of Covariance*

Expression quality is remarkable for the dance to transform into a fruitful mechanism of providing complacence to the dance and to the dancer simultaneously. Expression quality may be difficult to measure quite objectively, but some of the expert dancers may be able to evaluate this element to near perfection. It is imperative to recognise that this element of expression quality is quite an inherent relating to the emotional elegance of the dancer and the maturity of the facial muscles in terms of facilitation for the desired complex but sensitive movements. Hence, this quality may not be considered as just physical but it is neuro-physical in nature.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 41, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 41. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.24	3	0.08	1.35	0.2694
remainder	2.58	43	0.06		

Table 42. Analysis of Covariance for **Expression quality**

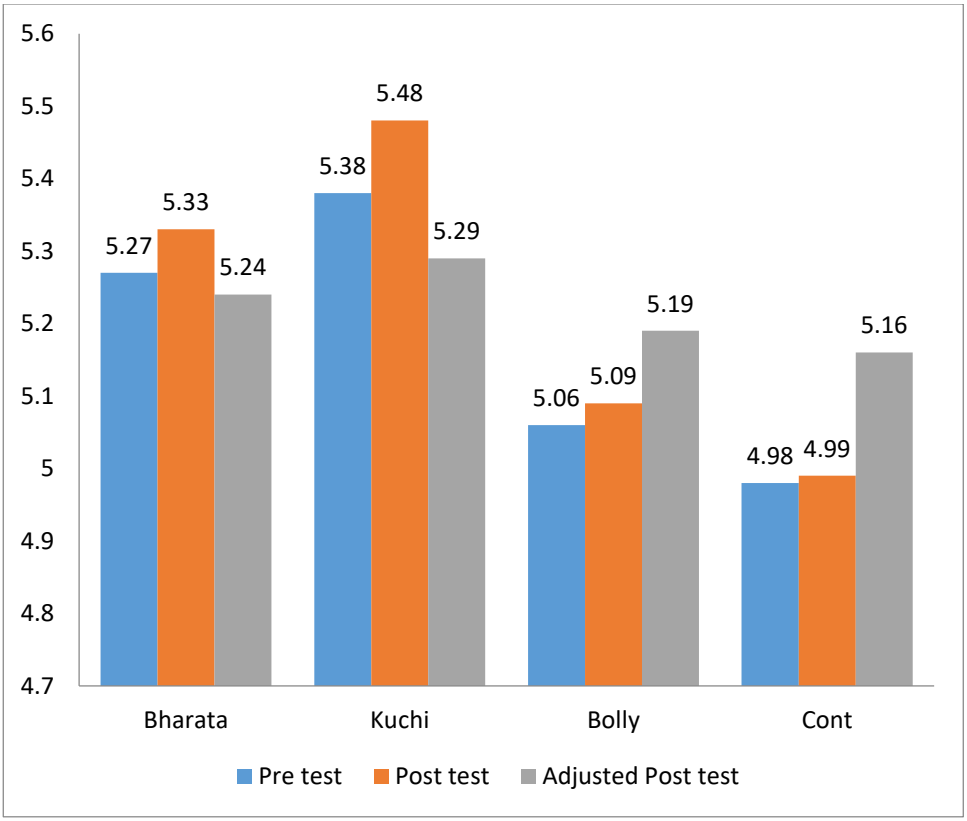
Source	SS	df	MS	F	P
adjusted means	0.09	3	0.03	0.48	0.6978
adjusted error	2.82	43	0.07		
adjusted total	2.91	46			

Analysis of Covariance as indicated in table 42, indicated that the three dance groups of the experimentation were not significantly different in the expression quality variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 0.48 is not significant at the P of 0.6978.

Table 43. Mean values for **Expression quality**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.27	5.33	5.24
Kuchi	5.38	5.48	5.29
Bolly	5.06	5.09	5.19
Cont	4.98	4.99	5.16

Figure 12. ***Pre, post and adjusted post-test values for*** **Expression quality**



The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.29 in terms of the expression quality variable, followed by Bharatanatyam group with 5.24, Bolly dance group with 5.19 and control group with 5.16. This enables to understand that the three groups of the study are significantly high in the mean value of the integration of limbs when compared to the control group of the study. Since, this numerical difference cannot be identified significant as the covariance analysis indicated that there was no significant difference among the experimental groups due to the experimental protocol and hence there is no need to further test through the Scheffe's post hoc individual comparison.

Connectedness of expression with music*: Analysis of Covariance*

There are several elements that make the dance fluid and meaningful to the spectators, expression of dancer synchronising with the music is one such element. High levels of orientation is essential for the dancer to produce expressions to perfectly sync with the ongoing music. Facial muscles neural connectivity and maturity of these neural connections along with required intensity of practice brings the expression of the dancer desired meaning to the dance. Highly complex coordinated facial muscle movements are difficult to achieve, unless possessed with highly matured afferent and efferent neurophysiology. General physical exercises may not be able to improve this quality in general though some improvement might be achieved.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 44, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 44. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.05	3	0.02	0.34	0.7988
remainder	1.97	43	0.05		

Analysis of Covariance as indicated in table 45, indicated that the three dance groups of the experimentation were not significantly different in the connectedness of expression with music variable from the control group due to the effect of the physical

exercise protocol training, as the obtained F value ie 1.33 is significant at the P of 0.2784.

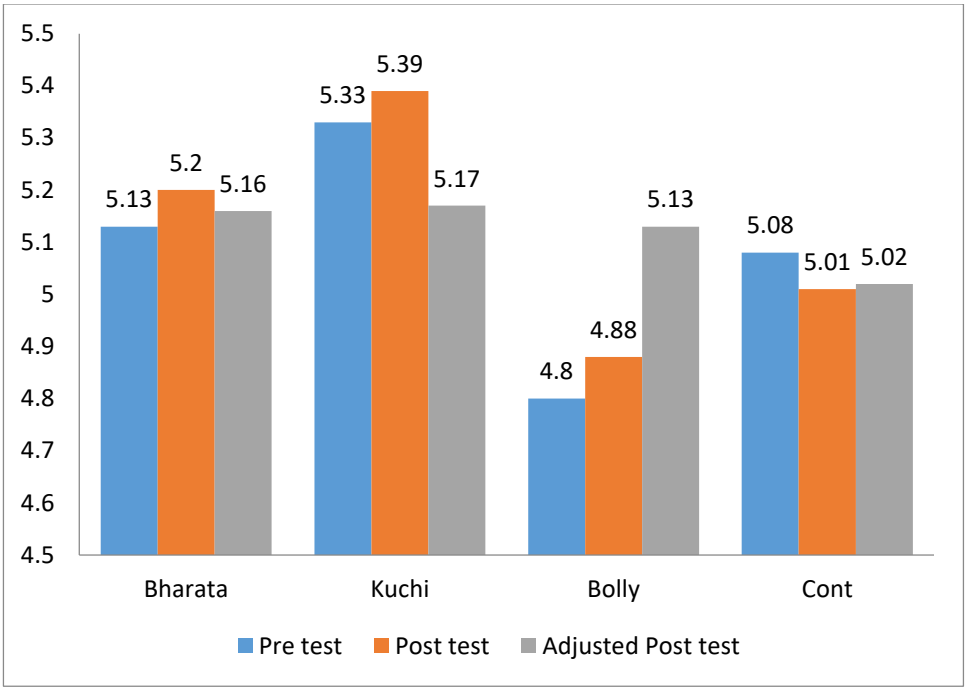
***Table 45. Analysis of Covariance for* Connectedness of expression with music**

Source	SS	df	MS	F	P
adjusted means	0.19	3	0.06	1.33	0.2784
adjusted error	2.02	43	0.05		
adjusted total	2.20	46			

***Table 46. Mean values for* Connectedness of expression with music**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.13	5.20	5.16
Kuchi	5.33	5.39	5.17
Bolly	4.80	4.88	5.13
Cont	5.08	5.01	5.02

Figure 13. *Pre, post and adjusted post-test values for* Connectedness of expression with music



The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.17 in terms of connectedness of expression with music, followed by Bharatanatyam group with 5.16, Bolly dance group with 5.13 and control group with 5.02. This enables to understand that the three groups of the study are significantly high in the mean value of the integration of limbs when compared to the control group of the study, but this numerical difference is not significant as per the covariance analysis and hence further analysis was not done with the Scheffe's post hoc test to find out the source of significant difference and the benefitted groups of the study.

Connectedness of expression with flow*: Analysis of Covariance*

Achievement of Connectedness of expression with flow of the dance movements is very difficult task for the dancer for throughout the dance performance

especially if the dance performance is a prolonged one. Flow of the dance may be considered as one of the speed dynamics aspects of the dance and may include speed and intensity of the dance movements basing on the music or audio element of the dance and the dancer has to produce expression to be in synchronisation with this speed dynamics like fastness and intensity of the dance. Physical and neural fatigue could hamper this particular component for a dancer especially when the dance performance extends to longer durations. Hence, enhancement in physical endurance like cardiovascular endurance could indirectly boost the connectedness of expression with flow of the dancer.

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 47, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 47. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.20	3	0.07	1.11	0.3544
remainder	2.61	43	0.06		

Analysis of Covariance as indicated in table 48, indicated that the three dance groups of the experimentation were not significantly different in the connectedness of expression with flow variable from the control group due to the effect of the physical

exercise protocol training, as the obtained F value ie 0.33 is not significant at the P of 0.8019.

***Table 48. Analysis of Covariance for* Connectedness of expression with flow**

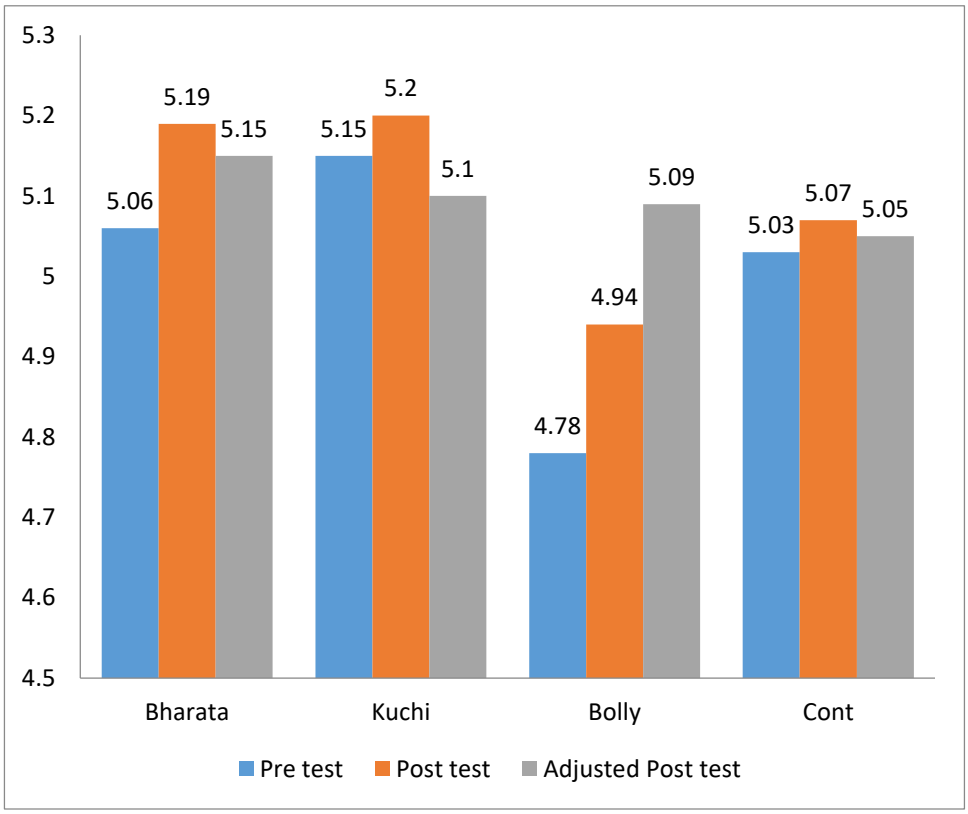
Source	SS	df	MS	F	P
adjusted means	0.07	3	0.02	0.33	0.8019
adjusted error	2.81	43	0.07		
adjusted total	2.88	46			

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Bharatanatyam group showed higher mean value ie 5.15 in terms of connectedness of expression with flow, followed by Kuchipudi group with 5.10, Bolly dance group with 5.09 and control group with 5.05. This enables to understand that the three groups of the study are significantly high in the

***Table 49. Mean values for* Connectedness of expression with flow**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.06	5.19	5.15
Kuchi	5.15	5.20	5.10
Bolly	4.78	4.94	5.09
Cont	5.03	5.07	5.05

Figure 14. ***Pre, post and adjusted post-test values for*** **Connectedness of expression with flow**



mean value of the connectedness of expression with flow when compared to the control group of the study, but this numerical difference is not significant as per the covariance analysis and hence further analysis was not done with the Scheffe's post hoc test to find out the source of significant difference and the benefitted groups of the study.

Complete body involvement*: Analysis of Covariance*

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 50, that the groups of the dancers

are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 50. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.06	3	0.02	0.38	0.7683
remainder	2.28	43	0.05		

Analysis of Covariance as indicated in table 51, indicated that the three dance groups of the experimentation were significantly different in complete body involvement variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 6.44 is significant at the P of 0.0011.

***Table 51. Analysis of Covariance for* Complete body involvement**

Source	SS	df	MS	F	P
adjusted means	1.05	3	0.35	6.44	0.0011
adjusted error	2.34	43	0.05		
adjusted total	3.40	46			

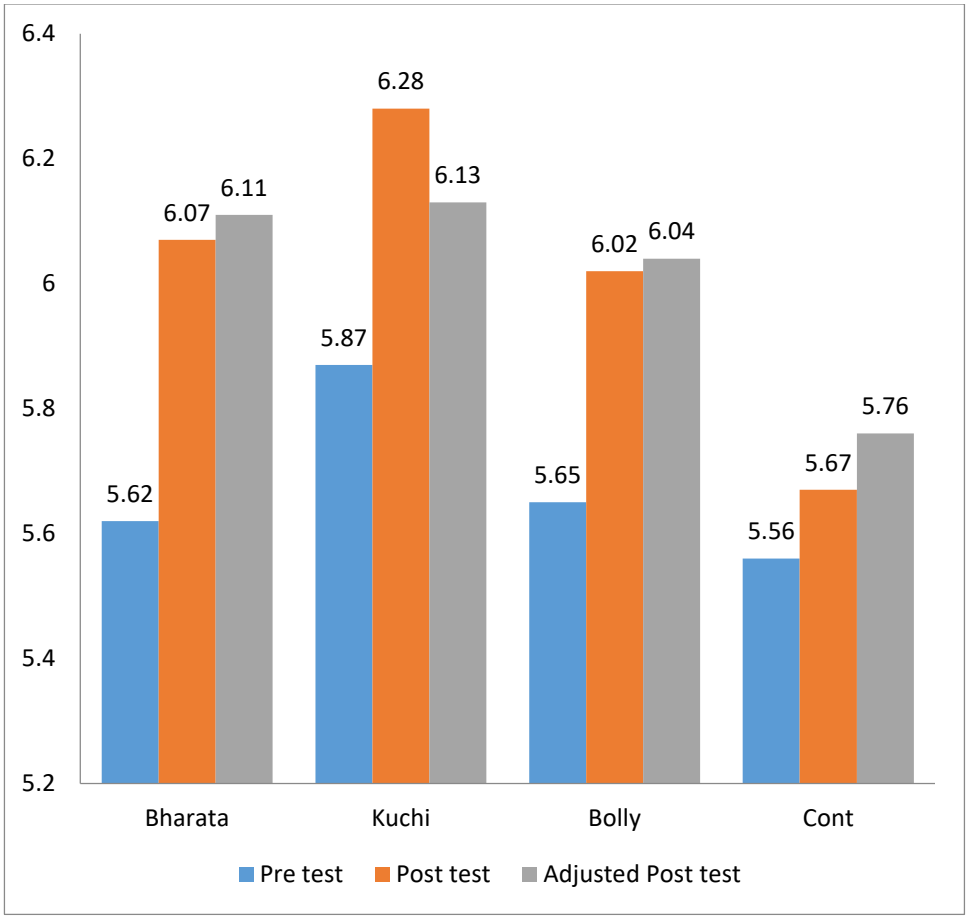
The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 6.13 in terms of the complete body involvement, followed by Bharatanatyam group with 6.11, Bolly dance group with 6.04 and control group with 5.76. This enables to understand that the three groups of the study are significantly high in the mean value

of the complete body involvement variable when compared to the control group of the study, but to understand whether this numerical difference is significantly higher

***Table 52. Mean values for* Complete body involvement**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.62	6.07	6.11
Kuchi	5.87	6.28	6.13
Bolly	5.65	6.02	6.04
Cont	5.56	5.67	5.76

Figure 15. ***Pre, post and adjusted post-test values for* Complete body involvement**



among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 53.

Table 53. Scheffe's post hoc individual comparison test

(CD = 0.34)

Means	6.13	6.04	5.76
6.11	-0.02	0.07	0.35*
6.13		0.09	0.37*
6.04			0.28

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 53 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.02), Bharatanatyam and Bolly groups (0.07), Kuchipudi and Bolly dance groups (0.09) and Bolly and Control groups (0.28). But, the post hoc analysis indicated that there was significant difference between Bharatanatyam and control groups (0.35) and between Kuchipudi and Control Groups (0.37) indicating that the both the Bharatanatyam and Kuchipudi groups could experience the significant improvement in their ability of complete body involvement when compared to the Bollywood dance group of the study.

Integration of limbs of the body*: Analysis of Covariance*

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 54, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 54. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.02	3	0.01	0.21	0.8888
remainder	1.15	43	0.03		

Analysis of Covariance as indicated in table 55, indicated that the three dance groups of the experimentation were significantly different in the integration of limbs

of the body variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 5.63 is significant at the P of 0.0024.

***Table 55. Analysis of Covariance for* Integration of limbs of the body**

Source	SS	df	MS	F	P
adjusted means	0.46	3	0.15	5.63	0.0024
adjusted error	1.16	43	0.03		
adjusted total	1.62	46			

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.35 in terms of the integration of limbs of the body, followed by Bharatanatyam group with 5.25, Bolly dance group with 5.23 and control group with 5.07. This enables to understand that the three groups of the study are significantly high in the mean value of the integration of limbs of the body when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 57.

***Table 56. Mean values for* Integration of limbs of the body**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	4.99	5.23	5.25
Kuchi	5.20	5.52	5.35

Bolly	4.94	5.15	5.23
Cont	4.96	5.01	5.07

Figure 16. ***Pre, post and adjusted post-test values for*** **Integration of limbs of the body**

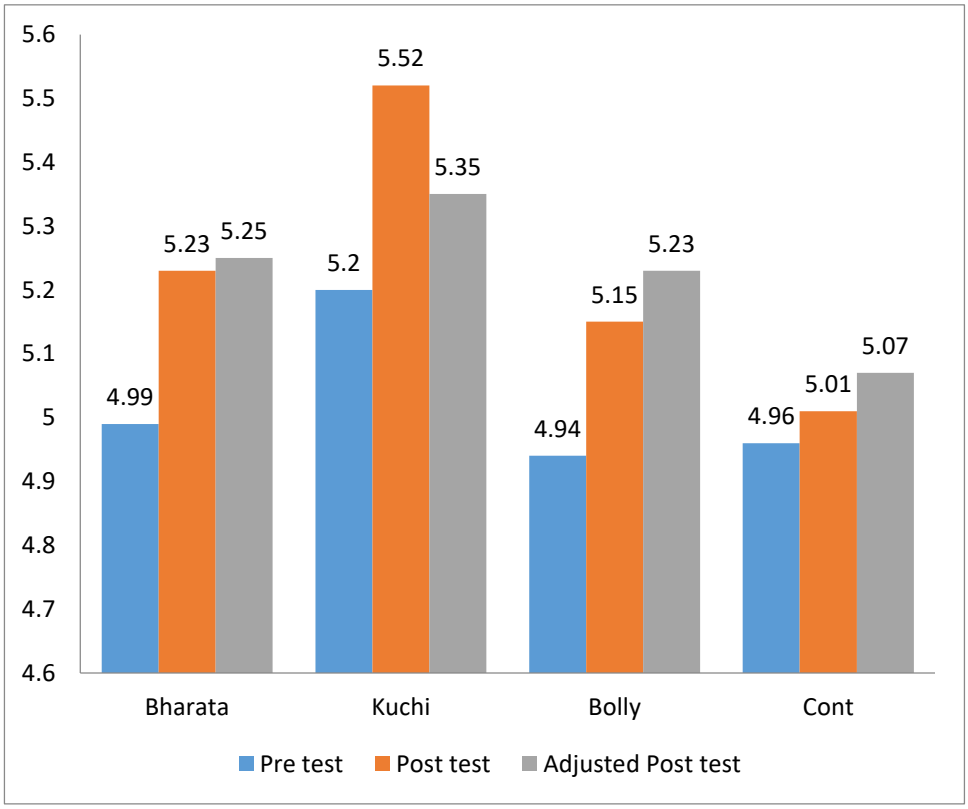


Table 57. Scheffe's post hoc individual comparison test

(CD = 0.24)

Means	5.35	5.23	5.07
5.25	-0.1	0.02	0.18
5.35		0.12	0.28*
5.23			0.16

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 57 elicits that there was no significant difference between Bharatanatyam and Kuchipudi groups in this variable (0.1), Bharatanatyam and Bolly groups (0.02), Bharatanatyam and control groups (0.18), Kuchipudi and Bolly dance groups (0.12) and Bolly and Control groups (0.16). But, the post hoc analysis indicated that there was significant difference between the Kuchipudi and Control Groups (0.28) indicating that the Kuchipudi group of the study could experience the significant improvement in their ability of integration of limbs of the body variable when compared to the other two groups of the dancers of the study.

Lower and upper limbs coupling and coordination*: Analysis of Covariance*

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 58, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 58. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.10	3	0.03	1.42	0.2508
remainder	0.98	43	0.02		

Analysis of Covariance as indicated in table 59, indicated that the three dance groups of the experimentation were significantly different in lower and upper limbs coordination and coupling variable from the control group due to the effect of the

physical exercise protocol training, as the obtained F value ie 4.76 is significant at the P of 0.006.

***Table 59. Analysis of Covariance for* Lower and upper limbs coupling and coordination**

Source	SS	df	MS	F	P
adjusted means	0.36	3	0.12	4.76	0.006
adjusted error	1.07	43	0.02		
adjusted total	1.43	46			

***Table 60. Mean values for* Lower and upper limbs coupling and coordination**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.43	5.60	5.55
Kuchi	5.56	5.81	5.64
Bolly	5.24	5.41	5.53
Cont	5.26	5.28	5.39

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.64 in terms of upper and lower limbs coupling and coordination variable, followed by Bharatanatyam group with 5.55, Bolly dance group with 5.53 and control group with 5.39. This enables to understand that the three groups of the study are significantly high in the mean value of the upper and lower limbs coupling and coordination variable when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of

the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 61.

Figure 17. ***Pre, post and adjusted post-test values for*** **Lower and upper limbs coupling and coordination**

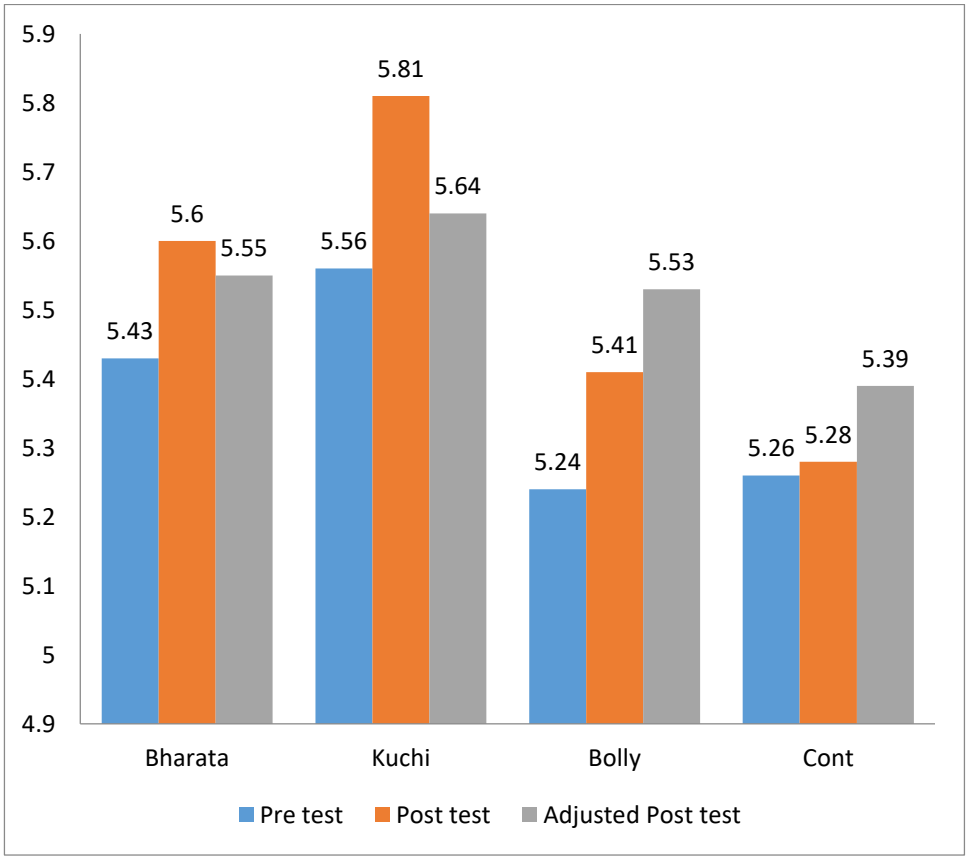


Table 61. Scheffe's post hoc individual comparison test

(CD = 0.18)

Means	5.64	5.53	5.39

5.55	-0.09	0.02	0.16
5.64		0.11	0.25*
5.53			0.14

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 61 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.09), Bharatanatyam and Bolly groups (0.02), Bharatanatyam and Control groups (0.16), Kuchipudi and Bolly dance groups (0.11) and Bolly and Control groups (0.14). But, the post hoc analysis indicated that there was significant difference between the Kuchipudi and Control Groups (0.25) indicating that the Kuchipudi groups could experience the significant improvement in the ability of upper and lower limbs coupling and coordination variable when compared to the other two groups of the dancers of the study.

Gross motor movement skills*: Analysis of Covariance*

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 62, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 62. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.06	3	0.02	0.85	0.4768
remainder	0.95	43	0.02		

Analysis of Covariance as indicated in table 63, indicated that the three dance groups of the experimentation were significantly different in the gross motor movement skills variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 12.2 is significant at the P of 0.000006.

***Table 63. Analysis of Covariance for* Gross motor movement skills**

Source	SS	df	MS	F	P
adjusted means	0.86	3	0.29	12.20	7E-06
adjusted error	1.01	43	0.02		
adjusted total	1.86	46			

***Table 64. Mean values for* Gross motor movement skills**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.29	5.60	5.59
Kuchi	5.49	5.80	5.65
Bolly	5.24	5.55	5.58
Cont	5.11	5.16	5.28

The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.65 in terms of the gross motor movement skills variable, followed by Bharatanatyam group with 5.59, Bolly dance group with 5.58 and control group with 5.28. This enables to understand that the three groups of the study are significantly high in the

mean value of the gross motor movement skills when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 65.

Figure 18. ***Pre, post and adjusted post-test values for*** **Gross motor movement skills**

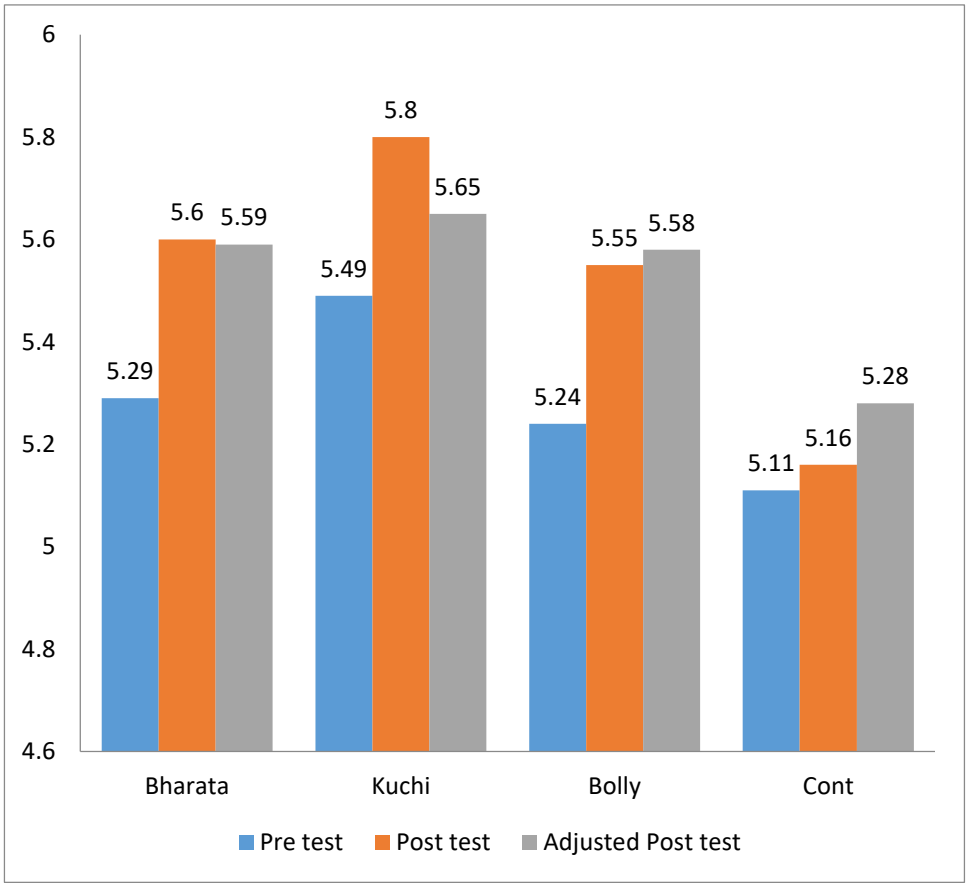


Table 65. Scheffe's post hoc individual comparison test

(CD = 0.3)

Means	5.65	5.58	5.28
5.59	-0.06	0.01	0.31*
5.65		0.07	0.37*
5.58			0.3*

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 65 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.06), Bharatanatyam and Bolly groups (0.01), Kuchipudi and Bolly dance groups (0.07). But, the post hoc analysis indicated that there was significant difference between the Bharatanatyam and Control groups (0.31), Kuchipudi and Control Groups (0.37) and also between Bollywood dance and control groups (0.30) indicating that all the three dance groups of the study could experience the significant improvement in the gross motor movement skills variable when compared to the control group of the study.

Expression integration*: Analysis of Covariance*

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 66, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 66. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.04	3	0.01	0.66	0.5782
remainder	0.82	43	0.02		

Analysis of Covariance as indicated in table 67, indicated that the three dance groups of the experimentation were not significantly different in the expression integration variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 2.19 is significant at the P of 0.1028.

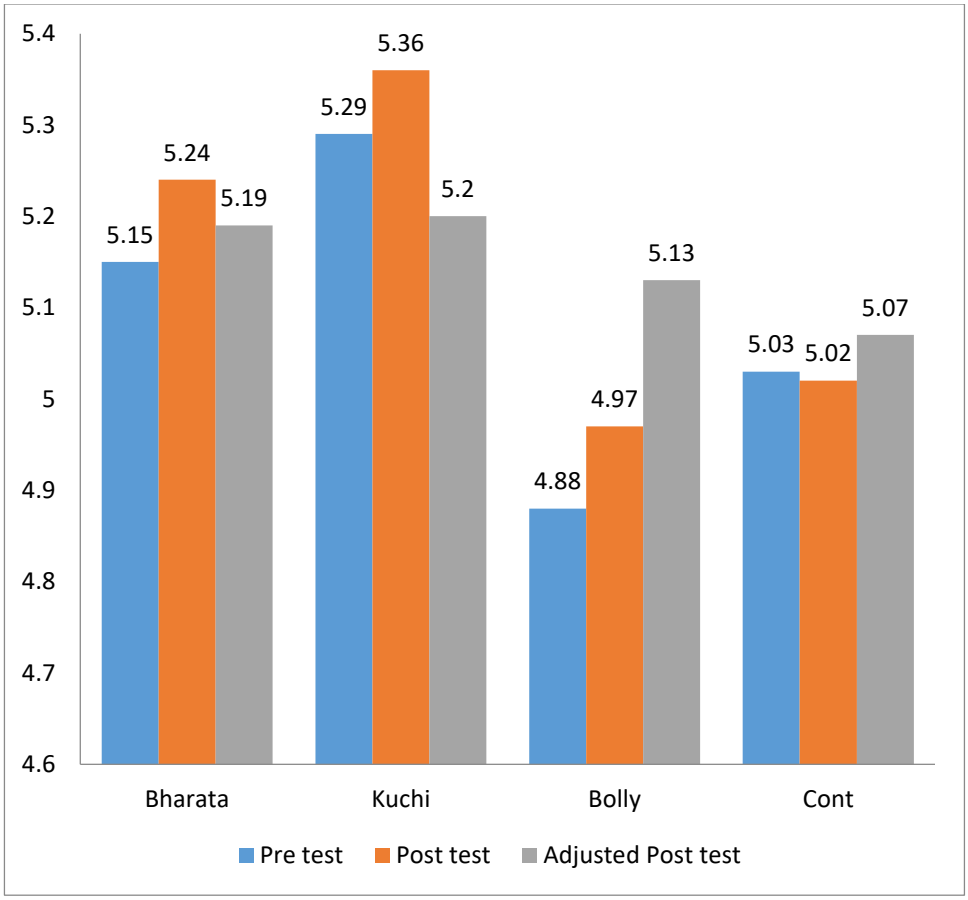
Table 67. Analysis of Covariance for: **Expression integration**

Source	SS	df	MS	F	P
adjusted means	0.13	3	0.04	2.19	0.1028
adjusted error	0.86	43	0.02		
adjusted total	0.99	46			

Table 68. Mean values for: **Expression integration**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.15	5.24	5.19
Kuchi	5.29	5.36	5.20
Bolly	4.88	4.97	5.13
Cont	5.03	5.02	5.07

Figure 19. ***Pre, post and adjusted post-test values for*** **Expression integration**



The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.2 in terms of the expression integration varaible, followed by Bharatanatyam group with 5.19, Bolly dance group with 5.13 and control group with 5.07. This enables to understand that the three groups of the study are significantly high in the mean value of the integration of limbs when compared to the control group of the study. Since, there was no significant difference observed in the covariable analysis, further analysis through the Scheffe's post hoc individual comparison was not done to find out the source of significant difference and for further explanation.

Total dance performance*: Analysis of Covariance*

When the scores were analysed through the analysis of covariance, the homogeneity of regression as indicated in table no. 69, that the groups of the dancers are initially equated in their abilities as there was no significant difference in the test of homogeneity of regression at the required power and significance level.

Table 69. Homogeneity of regression

Source	SS	df	MS	F	P
between regressions	0.00	3	0.00	0.19	0.9009
remainder	0.27	43	0.01		

Analysis of Covariance as indicated in table 70, indicated that the three dance groups of the experimentation were significantly different in the total dance performance variable from the control group due to the effect of the physical exercise protocol training, as the obtained F value ie 23.45 is significant at the P of 4E-09.

***Table 70. Analysis of Covariance for* Total dance performance**

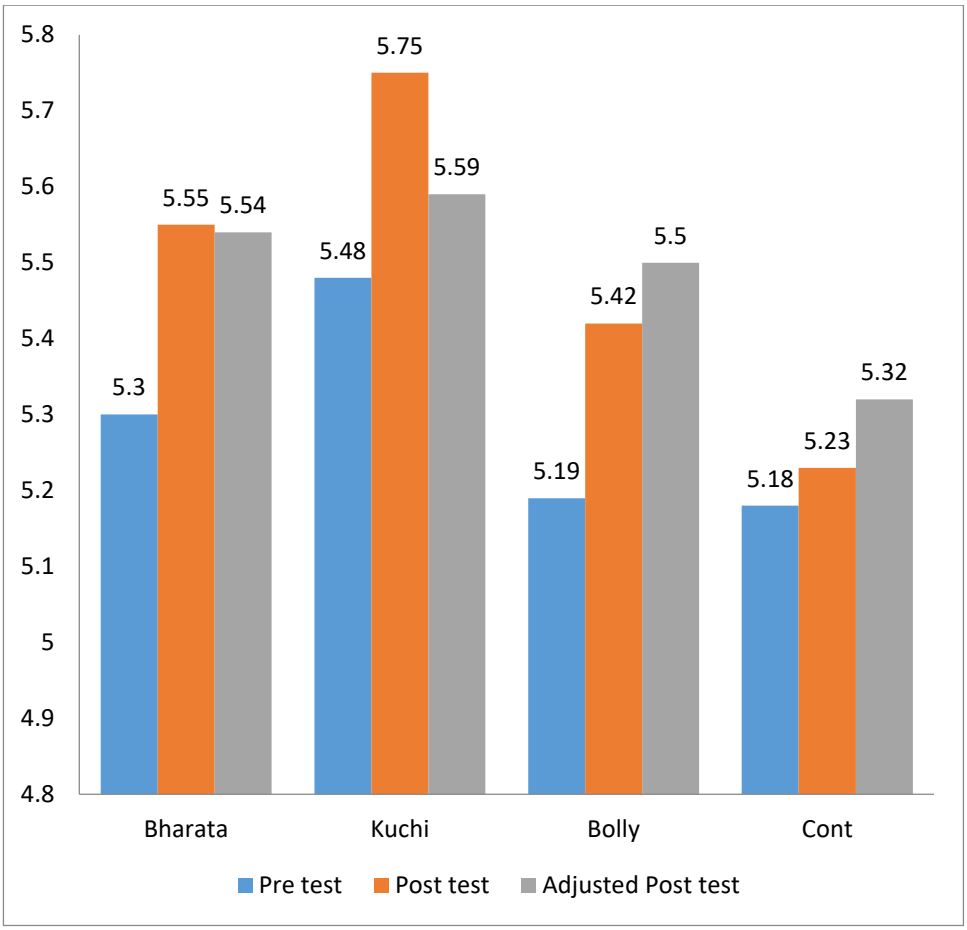
Source	SS	df	MS	F	P
adjusted means	0.44	3	0.15	23.45	4E-09
adjusted error	0.27	43	0.01		
adjusted total	0.71	46			

***Table 71. Mean values for* Total dance performance**

Group/mean	*Pre test*	*Post test*	*Adjusted Post test*
Bharata	5.30	5.55	5.54
Kuchi	5.48	5.75	5.59

Bolly	5.19	5.42	5.50
Cont	5.18	5.23	5.32

Figure 20. ***Pre, post and adjusted post-test values for*** **Total dance performance**



The comparison of mean values of the pre-test and the post test for the three groups of the study indicated that Kuchipudi group showed higher mean value ie 5.59 in terms of the total dance performance, followed by Bharatanatyam group with 5.54, Bolly dance group with 5.50 and control group with 5.32. This enables to understand that the three groups of the study are significantly high in the mean value of the total

dance performance when compared to the control group of the study, but to understand whether this numerical difference is significantly higher among the groups and find the source of the significant difference observed in covariance, further analysis was done with the Scheffe's post hoc test analysis as indicated in the table 72.

Table 72.Scheffe's post hoc individual comparison test

(CD = 0.24)

Means	5.59	5.5	5.32
5.54	-0.05	0.04	0.22
5.59		0.09	0.27*
5.5			0.18

*significant at 0.05 level

Scheffe's post hoc analysis as indicated in the table 72 elicits that there was no significant difference between Bharatnatyam and Kuchipudi groups in this variable (0.05), Bharatanatyam and Bolly groups (0.04), Bharatanatyam and Control groups (0.22), Kuchipudi and Bolly dance groups (0.09) and Bolly and Control groups (0.18). But, the post hoc analysis indicated that there was significant difference between the Kuchipudi and Control Groups (0.27) indicating that the Kuchipudi groups could experience the significant improvement in the variable of total dance performance when compared to the other two groups of the dancers of the study.

Discussion on results of the experimental study:

Discussion on the results of component 'Complete Body Involvement':

There are three sub components or subsets in this component. They are Axial control, Locomotor status and Energy maintenance.

Subset: Axial control

The statistical results elicited that both the Bharatanatyam and Kuchipudi groups of the study showed significant improvements in the axial control element of complete body movement when compared to the control group of the study because of the physical activity intervention of the study. But, the Bollywood dance group did not experience significant improvement in the axial control when compared to control group. There was also no significant difference between the Bharatanatyam and Kuchipudi groups with respect to the benefit gained through the physical activity intervention of the study for axial control element.

Subset: Locomotor status

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Locomotor status through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for Locomotor status because of the physical activity intervention of the study.

Subset "Energy maintenance*:*

Only Kuchipudi group of the study could experience the significant gain when compared to the control group of the study in Energy maintenance element through the physical activity intervention of the research study and other two groups viz Bharatanatyam and Bollywood dance group could not experience the significant

gains. Also there were no inter group differences with respect to the gained means for energy maintenance.

Discussion on the results for the factor 'Complete body involvement':

The results indicated that both the Indian classical dance groups of the study could be able to derive higher benefit through the physical activity intervention when compared to the Bollywood dance group of the study with respect to the complete body movement subsets. There were no gains for locomotor status for all the three groups and this may be attributed for the lack of graceful physical movements in the physical activity protocol of the study. The physical activity protocol of the study contained exercises that may foster for the enhanced physical fitness components which was reflected in the axial control and energy maintenance. Axial control could be identified with the coordination and coupling physical fitness components that may be gained through the physical activity intervention of the study.

Discussion on the results of component 'Integration of the limbs of the body':

There are three sub components or subsets in this component. They are Core support, Spinal involvement and Integration of segments during dance.

Subset: Core support

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Core support subset through the physical activity intervention of the research study and also there was no significant differences among the three

groups in terms of gained mean values for Core support because of the physical activity intervention of the study.

Subset: Spinal involvement

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Spinal involvement subset through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for Spinal involvement because of the physical activity intervention of the study.

Sub set: Integration of segments during dance

The statistical results elicited that only the Kuchipudi group of the study could be able to gain significantly in the sub set of Integration of segments during the dance when compared to the control group of the study and no other dance group could show the significant improvement in this subset when compared to the control group. Hence, only Kuchipudi dance group of the study could be able to get the benefit out of the physical activity intervention than Bharatanatyam and Bollywood dance groups.

Discussion on the results for the factor 'Integration of the limbs of the body':

The results indicated that only the Kuchipudi dance group of the study could be able to benefit out of the Physical activity protocol of the study with respect to the

Integration of the limbs of the body and Bharatanatyam and Bollywood dance groups did not gain statistically significant results in this area.

Discussion on the results of component 'Lower and upper limb coupling and coordination':

There are two sub components or subsets in this component. They are Lower limb connectivity to overall movement and Upper limb connectivity to overall movement.

Subset: Lower limb connectivity to overall movement

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Lower limb connectivity to overall movement subset through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for Lower limber connectivity to overall movement because of the physical activity intervention of the study.

Subset: Upper limb connectivity to overall movement

The statistical results elicited that only the Kuchipudi group of the study could be able to gain significantly in the sub set of Upper limb connectivity to overall movement when compared to the control group of the study and no other dance group could show the significant improvement in this subset when compared to the control group. Hence, only Kuchipudi dance group of the study could be able to get the benefit out of the physical activity intervention than Bharatanatyam and Bollywood dance groups.

Discussion on the results for the factor 'Lower and Upper limb coupling and coordination':

The results indicated that only the Kuchipudi dance group of the study could be able to benefit out of the Physical activity protocol of the study with respect to the Lower and Upper limb coupling and coordination ability and Bharatanatyam and Bollywood dance groups did not gain statistically significant results in this area.

Discussion on the results of component 'Gross motor movement skills':

There are three sub components or subsets in this component. They are agility. Balance and speed dynamics.

Subset: Agility

The statistical results elicited that all the three groups of the study viz the Bharatanatyam, the Kuchipudi and the Bollywood dance groups could be able to gain significantly in the sub set of agility when compared to the control group of the study and hence all the three groups got benefitted through the physical activity intervention in developing agility factor. But there was no inter group differences and mean gains in agility due to the physical activity intervention.

Subset: Balance

The statistical results elicited that only the Kuchipudi group of the study could be able to gain significantly in the sub set of Balance when compared to the control group of the study and no other dance group could show the significant improvement in this subset when compared to the control group. Hence, only Kuchipudi dance

group of the study could be able to get the benefit out of the physical activity intervention than Bharatanatyam and Bollywood dance groups.

Subset: Speed dynamics

The statistical results elicited that only the Kuchipudi and Bollywood dance groups of the study could be able to gain significantly in the sub set of Speed dynamics when compared to the control group of the study and Bharatanatyam dance group could not show the significant improvement in this subset when compared to the control group. Hence, only Kuchipudi and Bollywood dance groups of the study could be able to get the benefit out of the physical activity intervention than Bharatanatyam dance group.

Discussion on the results for the factor 'Gross motor movement skills':

The statistical results elicited that all the three groups of the study viz the Bharatanatyam, Kuchipudi and Bollywood dance groups of the study could be able to gain significantly in the component of Gross motor movement skills when compared to the control group of the study. Hence, all the three dance groups of the study could be able to get the benefit out of the physical activity intervention. There was no intergroup variation in the mean gains for the component.

Discussion on the results of component 'Expression integration':

There are three sub components or subsets in this component. They are Expression quality, Connectedness of expression with music and Connectedness of expression with flow.

Subset: Expression quality

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Expression quality subset through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for expression quality because of the physical activity intervention of the study.

Subset: Connectedness of expression with music

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Connectedness of expression with music subset through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for Connectedness of expression with music because of the physical activity intervention of the study.

Subset: Connectedness of expression with music

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Connectedness of expression with flow subset through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for Connectedness of expression with flow because of the physical activity intervention of the study.

Discussion on the results for the factor 'Expression integration':

The statistical results elicited that all the three dance groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups did not experience significant gains in Expression Integration component through the physical activity intervention of the research study and also there was no significant differences among the three groups in terms of gained mean values for expression integration because of the physical activity intervention of the study.

Discussion on the results for the 'Overall dance performance':

The statistical results elicited that only the Kuchipudi group of the study could be able to gain significantly in the factor of Overall dance performance when compared to the control group of the study and no other dance group could show the significant improvement in this factor when compared to the control group. Hence, only Kuchipudi dance group of the study could be able to get the benefit out of the physical activity intervention than Bharatanatyam and Bollywood dance groups with respect to the overall dance performance factor.

Discussion on hypotheses

Discussion on subjective hypotheses: *The discussion on the hypotheses for the subjective hypotheses would be based on the studies and credulous literature that was incorporated in the chapter II i.e. review of related literature. The review of related literature was presented with different sub headings and these sub headings were meant to discuss the following four subjective hypotheses of the research study.*

9. *Hypothesised that the dance has been an integral part of the fitness culture revolution both in India and across globe.*

Ever since the concept of fitness for health came into serious contemplation of the society, the human endeavour had been very noteworthy and scientific to find out ways and means to be healthy and lead into healthy aging. The science of fitness has understood that there are various components of fitness which all of them are very much essential for wholistic health of the individuals. The science of fitness is constantly trying to find out the best comprehensive mode of attaining the maximal fitness in terms of both quality and quantity. Since, the human beings health depends not only on the physical health of the person but also on the mental, emotional, social wellness of the individual. Hence, it is essential to find out a meaningful and comprehensive way to attain most of these wellness domains of the individuals to keep the individuals healthy. Several scientific studies have been clearly indicated that the dance could influence not only on the physical or physiological domain of the individual, but also could influence the neuropsychological, social domains of the individuals leading to enhanced emotional and social health of the individuals. Hence, dance had been recognised as a perfect medium to bring these changes in the people. With the advent and takeover of the fitness culture into society, dance has been a proven tool to enhance the fitness and health of individuals not only in India but also across the globe. Hence, the

hypothesis that the dance has been an integral part of the fitness culture revolution both in India and across globe was accepted.

10. *Hypothesised that the dance has been a medium of developing and maintaining aesthetic body culture.*

    It is pertinent for a dancer to be physically fit and also to be very physically aesthetic for the spectators. This particular element of the dance made the dancers to reach to the expectations of the society and always have to strive for this end. It is also true that those who practice dance regularly could attain excellent physical aesthetics which is appreciable by spectators. Both physical aesthetics and neuroaesthetics could very well be achieved through the dance practice and dance and also by observing dance as spectators. People start appreciating things both physically and psychologically due to neuroaesthetics changes the people experience. Hence, the hypothesis that the dance has been a medium of developing and maintaining aesthetic body culture was accepted.

11. *Hypothesised that the dance training and dance performances have become inseparable part of human endeavour for health and wellness.*

    Dance has been already recognised as a very powerful and comprehensive medium for enhancing the fitness and health because of its myriad advantages and its possible influence on the several wellness domains of individuals and thereby making the individuals to develop in wholesome and to attain a very good comprehensive health. Since, the dance activity

is also very natural movement for the human beings and also because it has the ability to bring happiness and euphoric outcome, people are very interested and attracted to involve in dance. Mushrooming of dance fitness studio and extensive spread of the dance movement and dance fitness revolution across the globe is the clear evidence for this. The dance fitness culture is spreading even in those societies where there are several restrictions. Hence, the hypothesis that the dance training and dance performances have become inseparable part of human endeavour for health and wellness was accepted.

12. *Hypothesised that the dance with its inherent ability of motivating people for physical activity became a very leading and effective form of physical training for fitness and health enhancement.*

    Physical activity is necessary for enhancing fitness and health. Physical activities may be in the form of exercises, running, dancing etc. Physical activity in general is a painful activity and needs high levels of internal motivation to continue to engage in high intensity exercise protocols to keep fitness levels and to possess optimal health. This factor of pain causes for the people to possess to have lot of interest and motivation as the general exercises unless thoroughly addicted may not be able to provide euphoric effect or happiness effect which may be essential for individuals to continue to participate in high intensity sustained physical activities for sufficiently long time. But, dance with its inherent character of providing

happiness factor to the individuals involved in dancing leading to suppression in pain signals, make people to continue to engage in the dancing lessons or dance training for sufficiently long time without getting demotivated. Moreover, the neuroaesthetics effect of the dancing could also cause to start self-appreciating the one's own physical aesthetics causing enhanced interest in the dance training. Hence, the hypothesis that the dance with its inherent ability of motivating people for physical activity became a very leading and effective form of physical training for fitness and health enhancement was accepted.

Discussion on Objective hypotheses:

The following objective hypotheses were formulated at the beginning of the study for the experimental protocol of the study which was an inherent part of the present research endeavour.

1. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the complete body involvement and its subsets of the three dance groups of the study.*

The results indicated that the Bharatanatyam and Kuchipudi dance groups only gained significant improvement in the subset of axial control, only Kuchipudi group gained significant improvement in the subset of energy maintenance and no single dance group of the study could gain significantly in the subset of locomotor status. The results also indicated that only the Bharatanatyam and Kuchipudi dance groups of the study

could gain significant improvements in the main component of complete body involvement and hence the hypothesis that the selected physical exercise protocol of the study would show significantly positive effect on the complete body involvement and its subsets of the three dance groups of the study was rejected.

2. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the integration of the limbs of the body and its subsets of the three dance groups of the study.*

The results indicated that all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups could not gain significantly in the subsets of Core support and Spinal Involvement, whereas only Kuchipudi dance group of the study could gain significantly in the subset of Integration of segments during the dance. Whereas with respect to the main component i.e. Integration of the limbs of the body only Kuchipudi group could show significant improvement and hence the hypothesis that the selected physical exercise protocol of the study would show significantly positive effect on the integration of the limbs of the body and its subsets of the three dance groups of the study was rejected.

3. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the lower and upper limb coupling and coordination and its subsets of the three dance groups of the study.*

The results indicated that all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups could not be able to gain significantly in the

Lower limb connectivity to overall dance movement and only the Kuchipudi dance group of the study could be able to benefit out of the Physical activity protocol of the study with respect to the Upper limb connectivity to overall dance movement and also with respect to the main component of Upper limb coupling and coordination ability and Bharatanatyam and Bollywood dance groups did not gain statistically significant results in this area and hence the hypothesis that the selected physical exercise protocol of the study would show significantly positive effect on the lower and upper limb coupling and coordination and its subsets of the three dance groups of the study was rejected.

4. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the gross motor movement skills and its subsets of the three dance groups of the study.*

The results indicated that all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups could gain significantly in the subset of agility, whereas only Kuchipudi dance group of the study could gain significantly in the subset of balance and only Kuchipudi and Bollywood dance groups of the study could gain significantly in the subset of speed dynamics. The results also indicated that all the three groups of the study could gain significantly in the main component ie Gross motor movement skills when compared to control group. Hence that portion of the hypothesis that the selected physical exercise protocol of the study would show significantly positive effect on the gross motor movement skills was accepted whereas

that portion that the selected physical exercise protocol of the study would show significantly positive effect on the subsets of the component of gross motor movement skills for all the three groups was rejected.

5. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive effect on the expression integration and its subsets of the three dance groups of the study.*

The results indicated that all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups could not gain significantly with respect to the main component of Expression integration and for all the three subsets of the component viz expression quality, connectedness of expression with music and connectedness of expression with flow and hence the hypothesis that the selected physical exercise protocol of the study would show significantly positive effect on the expression integration and its subsets of the three dance groups of the study was rejected.

6. *Hypothesised that the selected physical exercise protocol of the study would show significantly positive impact on the overall dance performance levels of the selected three dance groups of the study.*

The results indicated that only the Kuchipudi dance group of the study could be able to gain significantly in the overall dance performance when compared to the Bharatanatyam and Bollywood groups of the study and hence the hypothesis that the selected physical exercise protocol of the study would show significantly

positive impact on the overall dance performance levels of the selected three dance groups of the study was rejected.

CHAPTER - V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY:

Introduction and background of the study: Dance has been an integral part of human cultures since time immemorial. Though rhetoric evidence may not be available about the origins of dance there were many reasons why the dances were practiced by humans. Religious, social differences brought different dance forms into vogue and now the dance has become very influencing medium of human enrichment. Religious reasons could have ascribed for most of the dance forms of the world, but the social reasons too are dominant in the origin and spread of the dance forms. Indian sub-continent is accredited for having given birth to many charismatic and highly appealing dance forms like Bharatanatyam, Kuchipudi, Kathak etc. There are several dance forms that existed in ancient Greece and Italy as religious practices mainly. In Europe, social dancing has been so prominent and these social dances provided rostrum for the social integrity and social evolution in Europe. Salsa in western world is very electrifying dance and Bhangra can be compared as similar in India.

Dancing has been recognized as a physical skill that requires expert motor actions from the individual or groups of individuals to make the dance very meaningful and appealing. Indian classical dances are highly complex in terms of execution of body movements as almost all the classical dance sequences are performed along with a music track that needs excellent coordination. Some dances like Salsa, Rock etc need

high levels of physical fitness to perform and some dances require dexterity in coupling the body segments.

Physical fitness helps people to equip better health fitness and consequently better health. Improvement in physical fitness can enhance the functional fitness of the organs of the body. It is important to understand the science of functional fitness so that the specific targets can be set and exploited with scientific temper. It is undeniable fact that the modern day society is slowly getting attracted towards a healthy lifestyle after seeing the devastating ill effects of disease plagued societies across the globe. It is important to understand that the dancing is a physical activity which requires relevant functional fitness to excel in certain dance protocols or certain forms of dancing. At the same time, it is also true that regular dance training and practice can enhance the functional physical fitness of the individual depending on the type of dance or dance movements practiced. It is scientific to realize that to excel in particular dance style, the dancers need to undergo specialized training that will supplement the dance training with additional care and this makes the dancer to perform the dance movements with more ease and grace. Cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, coordination and coupling are some common physical fitness factors that would certainly protect and enhance the dance performances and dancers. Injury proneness of the dancer may also be tackled through the supplementary exercise that would tone up the relevant muscles and joints to be able to tolerate the stress of repeated dance movements.

The fitness revolution has created a peculiar fitness culture across the globe and this fitness culture seems exerting enormous desire in the societies to adapt all possible ways, means and methods to enrich the fitness and health levels. The constant efforts and exploration of fitness freaks had made the dance to be used as a means of fitness enhancer. The scientific studies clearly mentioning that the dance can provide physical fitness, mental and emotional fitness simultaneously, because of its inherent nature of being so expressive. Simultaneous physical exertion and happiness through the dance activity, individuals can get more benefits than the general physical activity protocols. Physical culture has assimilated the dance as an integral part of the physical fitness tool. Steadily the offering of dance as fitness means by the fitness centres are growing and in fact the society is now witnessing the mushrooming of dance centres exclusively to provide fitness classes through the dance training and dance activities. The advent of Bollywood dance style has provided further impetus to this movement and now the there are several Bollywood style dance studios are offering fitness classes through Bollywood dances not only across India but also in western world.

The present research tries to ascertain the valid and credible reasons and premises, why the dance training and dancing has become a part of fitness regime of several individuals and why the dance has become a highly influencing factor of fitness medium in the matters of fitness training and fitness culture. The present research study was aimed to find out the ingredients of dance culture in societies, understand and detail the concepts of dance as training and as performance, delineate the difference

between the dance fitness and fitness in dance and also to objectively analyse the relationship between the determinant factors of dance and dance training.

Methods used in the research study:

There were two methods used in this study. A. One method (subjective method) examined and analyzed critically to understand few questions like

10. *Identifying the elements of dance training and dance performance.*
11. *Understanding and detailing the distinction and relationship between the dance training and dance performance.*
12. *Identifying and detailing the progression of fitness, especially the physical fitness form and how the physical fitness influenced the ancient and modern civilizations of mankind.*
13. *Detailing the revolution of fitness industry and fitness as a medium for gaining health and wellbeing etc.*

B. The second method (Objective method) in this research study was an experimental method. The main premise of this experimental investigation was to bring out the importance of physical fitness program on the dancing fitness and consequent changes in different factors of dance performance. A total of four groups with twelve dancers as subjects in each group underwent physical exercise protocol for three times in a week apart from their routine dance practice for six months. Three groups represented Bhratanatyam, Kuchipudi and Bollywood style forms whereas the fourth group assisted as control group

for comparison. The dance performance was measured two times, one at the initiation or at the beginning of the study and finally at the end of the study after the six months of experimentation period. The pretest and posttest values of the dance performances of the four groups were analysed with the help of Analysis of Covariance (ANCOVA) at 0.05 significance level and further with the Scheffe's post hoc tests for obtaining results of the study and to make further discussion with respect to the results of the study basing on the statistical analysis.

CONCLUSIONS:

The following conclusions were drawn out of the objective experiment and subjective experiment.

A. Subjective conclusions: the following conclusions were derived from the subjective analysis of the hypotheses concepts through application of critical analysis, verification, questionnaires and through journal verifications.

1. Physical fitness is essential to perform the dance more effectively, with proper grace and rhythm.
2. Enhancements in physical fitness can bring positive changes in the dance performances quality and sustainability factors of dancers.
3. Participation in dancing and dance training could lead to enhanced physical fitness and consequent enhancements in functional fitness of individuals.

4. Augmented functional fitness is highly essential to enhance the dance performances of the dancers.
5. Elevated physical fitness can elevate the health fitness of the participants and could lead to enhanced health benefits and health.
6. Dance training can foster for elevation of not only physical fitness, but also contribute for the enhancements in mental, emotional and social fitness leading to higher order wellness of individuals.
7. Dance training and dance participation can bring improved aesthetics in terms of physical appearance.
8. Neuroaesthetics can be improved within individuals through regular dance training.
9. Dance performances of individuals can be enhanced by implementing supplemental physical training based on scientific exercise principles.
10. Widespread fitness culture has accepted the dance as a medium of achievement for higher order fitness across the globe.
11. Dance can provide sustainable motivation to individuals to involve in physical activity programs for long time and hence dance can be considered as an effective form of physical training for health and also for wellness.

B. Objective conclusions: the following conclusions were derived through the experimentation part of the research study.

1. Physical activity intervention protocol of the study caused significant improvements in the axial control levels of the Bharatanatyam and Kuchipudi groups of the study but not for Bollywood dance group.
2. Physical activity intervention protocol of the study could not cause any significant changes in the Locomotor status of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.
3. Physical activity intervention protocol of the study caused significant improvements in the energy maintenance variable of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.
4. Physical activity intervention protocol of the study could not cause any significant changes in the Core support variable of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.
5. Physical activity intervention protocol of the study could not cause any significant changes in the Spinal involvement variable of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.
6. Physical activity intervention protocol of the study caused significant improvements in the Integration of limbs during the dance variable of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.
7. Physical activity intervention protocol of the study could not cause any significant changes in the Lower limb connectivity to overall movement

variable of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.

8. Physical activity intervention protocol of the study caused significant improvements in the Upper limb connectivity to overall movement variable of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.
9. Physical activity intervention protocol of the study caused significant improvements in the Agility variable of the all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.
10. Physical activity intervention protocol of the study caused significant improvements in the balance variable of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.
11. Physical activity intervention protocol of the study caused significant improvements in the speed dynamics variable of the Kuchipudi and Bollywood dance groups of the study only but not for Bharatanatyam dance group.
12. Physical activity intervention protocol of the study could not cause any significant changes in the expression quality variable of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.
13. Physical activity intervention protocol of the study could not cause any significant changes in the connectedness of expression with music variable of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.

14. Physical activity intervention protocol of the study could not cause any significant changes in the connectedness of expression with flow variable of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.
15. Physical activity intervention protocol of the study caused significant improvements in the complete body involvement component of the Bharatanatyam and Kuchipudi groups of the study only but not for Bollywood dance group.
16. Physical activity intervention protocol of the study caused significant improvements in the integration of the limbs of the body component of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.
17. Physical activity intervention protocol of the study caused significant improvements in the lower and upper limbs coupling and coordination component of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.
18. Physical activity intervention protocol of the study caused significant improvements in the gross motor movement skills component of all the three groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups of the study.
19. Physical activity intervention protocol of the study could not cause any significant changes in the expression integration component of all the three

groups of the study viz Bharatanatyam, Kuchipudi and Bollywood dance groups.

20. Physical activity intervention protocol of the study caused significant improvements in the total dance performance of the Kuchipudi group of the study only but not for Bharatanatyam and Bollywood dance groups.

RECOMMENDATIONS:

The following recommendations are made basing on the conclusions derived from subjective and experimental studies conducted in the present research.

1. Fitness industry need to explore the scientific ways of including the dance training as part of fitness training.
2. Wellness managers need to incorporate dance training schedules as part of their endeavour to promote wellness among the society.
3. Dance may be incorporated for bringing positive changes in the neuropsychiatric patients also as the dance can bring positive neuroplasticity.
4. Dance may be encouraged as a fitness tool by the communities and nations. Governments should encourage the dance training as part of school curriculum to enhance to physical, mental and emotional fitness of children in schools as the dance is very cost effect sport like physical activity.
5. Efforts should be made to extend dances to elderly communities for healthy aging of the adults.

6. Dance practice and dance participation should be conducted on very scientific lines keeping in view of the differences in sex, age and other special conditions of participants.
7. Dance practice must be supplemented with the complementary scientific exercise sessions to prevent possible dance injuries both to the professional dancers or to recreational and health dancers.
8. Efforts must be made by the dance trainers to understand the dance physiology, dance kinesiology, dance medicine etc to impart dance movements on very scientific lines to enhance the performances.
9. Dance trainers need to understand the essentiality of different physical fitness components that are required for a particular dance form and to develop those fitness components as per the required proportions.
10. Dance training and dance learning are inter-disciplinary in approach and hence the dance trainers, professional dancers and other fitness trainers who impart dance for physical fitness need to consult the relevant experts like exercise physiologists, kinesiologists, physiotherapists etc.
11. Create positive environment for the favourable inclusion of dance kinesiology as a curricular subject matter for the dance training and dance study programs.
12. Initiative should pave way for acceptable inter-disciplinary approaches both in the curricular aspects of Indian classical dance courses and training and also in the research areas of the Indian classical dances.

13. The dance imparting agencies and the departments of dance offering course need to explore ways and means to set up research with both subjective and objective research premises, and should initiate steps to pave way for more similar kind of researches in the area of Indian classical dances, modern and fusion dances of India and across the globe.
14. Efforts should be made to identify the importance of the knowledge of exercise physiology/dance physiology, exercise kinesiology/dance kinesiology, exercise medicine/dance medicine, exercise psychology/dance psychology etc. Sincere efforts to enhance the utility of the subjects like movement or exercise physiology, sports medicine, dance kinesiology, dance psychology etc. in the area of dance studies, dance practice, dance training and dance performances.

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Component: Complete Body Involvement

Subset: Axial control

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.7	6.4	5.3	5.6	5.5	6.2	4.6	4.5
4.8	5.7	4.9	5.8	4.7	5.5	6.2	6
6.1	6.4	7.4	7.5	6.2	6.1	5.8	6.1
5.3	5.5	5.8	7	5.7	6.2	7.2	6.9
5.8	5.7	6.6	7.1	5.6	5.5	4.9	5.3
5.5	5.8	6	6.2	5.9	5.8	6.3	6.6
4.4	5.9	7.4	7.5	7.1	7.5	5.8	6.2
4.9	6.1	4.8	5.8	7	7.3	6.7	6.4
6.7	6.9	6.1	6	5.3	5.8	5.9	6.1
7.1	7.2	6.4	6.3	4.8	5.5	5.5	5.8
5.8	6.3	5.9	6.4	6.4	6.7	6.1	6.2
6.2	6.9	7.2	7.3	6.2	6.6	5.7	5.4
5.691667	**6.233333**	**6.15**	**6.541667**	**5.866667**	**6.225**	**5.891667**	**5.958333**

Subset: Locomotor status

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.2	6	6.1	6.2	6.1	6.5	5	4.9
5.3	5.5	5.3	5.5	5.2	5.4	5.7	6
5.5	5.6	5.9	5.6	5.8	6	5.4	5.5
5.8	6.2	5.5	5.8	5.9	6.4	6.9	6.7
6.2	6	7	7	5.3	5.4	5.3	5.5
6	6.5	6.3	6.6	5.5	5.6	6	6.2
5.3	5.7	6.8	7.7	6.8	6.6	6.1	6
5.5	5.4	5.1	6.3	6.9	7.3	6.6	6.5
6.4	6.6	6.7	6.1	6.2	7	6.4	6.8
6.8	7.2	7.2	6.6	5.3	6.4	5.9	6.3
6.1	6.9	5.4	6.5	6.6	6.9	5.5	5.8
6.5	7	6.4	7.4	6.1	6.1	5.4	5.3
5.883333	**6.216667**	**6.141667**	**6.441667**	**5.975**	**6.3**	**5.85**	**5.958333**

Subset: Energy maintenance

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
4.3	4.8	5.3	6	4.3	5.3	4.2	4.4
5.1	5.8	4.7	5.1	4.7	5	4.4	4.8
4.9	6.1	5.3	5.4	4.4	5.1	4.7	5
4.7	5.3	5.7	6.3	4.8	6	5.6	5.5
5.7	6.3	6.2	6.9	5.5	6.2	5.5	5.4
5.3	5.5	5.9	7	5.2	5.5	5.2	5.5
4.8	5.1	5.5	7.1	5.8	5.6	4.8	5
4.9	5	5.3	5.5	6.3	5.9	6	5.8

5.7	6.2	5.6	5.5	4.8	5	5.3	5.4
6.3	6.6	5.2	5.4	4.5	5	4.8	5.2
5.5	6	4.3	5	5.6	5.6	4.4	4.3
6.1	6.4	4.9	5.2	5.3	6.3	4.2	4.7
5.275	**5.758333**	**5.325**	**5.866667**	**5.1**	**5.541667**	**4.925**	**5.083333**

Component: Integration of limbs of the body

Subset: Core support

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
4.5	4.9	4.1	4.4	4.3	4.5	3.9	4.1
4.2	4.4	4.2	4	4	4.3	5	5.2
4.7	4.5	5.4	5.2	5.1	4.8	4.6	4.5
5.2	5.3	5.1	5.4	5	4.9	5.2	4.8
5	4.8	5.7	5.9	5.4	5.3	4.4	4.6
5.1	5.5	5	5.4	5.3	5.9	4.9	5.3
4	4.3	4.8	5.2	5.7	6.3	5	5.1
4.6	4.9	5.2	5.5	5	5.5	5.6	5.5
5.3	6	5.5	5.6	5.1	5	5.2	5.5
5.2	5.7	5.3	5.5	4.2	4.1	4.8	5
5	5.3	5.2	6	4.9	4.8	5.2	5.8
4.9	4.7	5.6	6.1	5.4	6.2	4.7	4.2
4.808333	**5.025**	**5.091667**	**5.35**	**4.95**	**5.133333**	**4.875**	**4.966667**

Subset: Spinal involvement

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
4.2	4.5	4.3	4.7	4	4.3	4.2	3.8
3.9	4.1	4	4.1	3.5	3.8	4.4	4.3
5	4.9	4.6	4.4	4.8	5.4	3.8	4
5.1	5.2	4.8	4.7	4.5	4.3	3.9	4.2
4.7	4.9	5.5	5.8	4.9	5.7	4.3	4.7
4.5	4.7	4.4	5	5.1	5	5	5.2
3.3	3.6	4.7	5.1	5.5	5.3	5.7	5.4
4.2	4.2	4.3	4.3	4.4	4.5	5.3	5
5.5	5.8	5.2	5.8	3.8	4	4.6	4.4
5.7	6.1	5.5	6.2	3.7	4.1	4.7	4.9
4.6	4.4	5.6	5.4	5.3	4.8	5.4	5.5
5.3	5.2	4.8	5	5	4.9	5	5.2
4.666667	**4.8**	**4.808333**	**5.041667**	**4.541667**	**4.675**	**4.691667**	**4.716667**

Subset: Integration of segments during dance

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**

5.2	5.8	5.3	6.1	4.8	5	4.9	5.1
5.8	6.4	5.1	5.5	5	5.1	5.2	5
5.7	6	6	6.2	5.3	5.5	5	5.1
6.2	6.5	6.3	6.6	5.5	5.8	4.9	5.3
5.1	5.4	5.4	5.7	5.2	5.4	5.4	5.3
4.8	5.1	5.2	5.9	5.8	6	5.2	5
5.4	5.3	5.7	6.5	5.6	6.3	5.9	5.7
5.5	5.6	6.4	6.5	6	6.3	6	6.1
5.2	5.5	5.1	6	5.3	5.8	5.4	6
6.2	6.7	5.9	6.1	5	5.4	5.3	5.5
5.7	6	5.7	6.3	5.7	5.8	5.7	5.4
5.3	5.9	6.2	6.7	4.8	5.2	4.8	4.7
5.508333	**5.85**	**5.691667**	**6.175**	**5.333333**	**5.633333**	**5.308333**	**5.35**

Component: Lower and Upper limbs coupling and coordination

Subset: Lower limb connectivity to overall movement

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.5	5.9	5.6	5.5	5	5.2	5.1	5.3
5.4	5.5	5.5	5.9	5.2	5.5	5.5	5.6
5.2	5.4	5.7	6	5.4	5.8	5.3	5.2
6	6.2	5.9	6.1	5.2	5	5	5.2
5.5	5.9	5.3	5.5	5.6	5.3	5.5	5.9
5	5.5	5	5.2	5.1	5.2	4.9	5
5.3	5	6	6.6	5.5	5.9	5.6	5.2
5.7	5.4	6.1	6.5	5.4	5.3	5.8	5.5
5.1	4.9	5.4	5.5	5.6	6	5.1	5.3
6.3	6.6	5.6	5.7	4.8	4.9	5.5	5.4
5.8	5.7	5.5	5.8	5.4	5.5	5	5.1
5.5	6.1	6	6.2	4.8	5.3	5.6	5.6
5.525	**5.675**	**5.633333**	**5.875**	**5.25**	**5.408333**	**5.325**	**5.358333**

Subset: Upper limb connectivity to overall movement

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
4.9	5.3	5.4	5.5	4.4	4.5	4.5	4.4
5.2	5.7	5.1	5.5	4.9	5	4.9	4.6
5.5	5.9	5.5	5.6	5.3	5.4	5.2	5.4
5.6	5.5	5.5	6	5.5	5.5	5.3	5.5
5.3	5.5	5.7	6.3	5.4	5.9	5.9	5.8
5.2	5.1	5.2	5.4	5.7	6	4.6	5
5.8	6	5.8	5.9	5.1	5.2	5.2	5
5	5.3	5.6	5.9	5.6	5.4	5.5	5.3
4.8	5	5.3	5.5	5.9	6.2	5.3	5.5
5.6	6.1	5.9	6.3	5	5.4	5.8	5.6

5.3	5.4	5.2	5.3	4.8	5.1	4.8	5
5.9	5.6	5.6	5.8	5.2	5.4	5.3	5.4
5.341667	**5.533333**	**5.483333**	**5.75**	**5.233333**	**5.416667**	**5.191667**	**5.208333**

Component: Gross Motor movement skills

Subset: Agility

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.2	5.7	5.5	6.1	4.9	5.3	4.8	5.2
5	5.1	5.2	5.7	5.2	5.1	5	4.8
5.6	6	5.9	6.2	5.5	5.6	5.5	5.3
5.3	6.1	5.3	5.4	5	5.4	5.3	5.4
5.7	5.9	5.5	5.8	5.1	5.7	6	5.8
4.9	5.3	5.7	6	5.5	5.6	5	5.3
5.5	5.8	6	6.4	5.4	6.2	4.8	4.7
5.1	5.5	5.3	5.5	6	6.3	5.1	4.9
4.6	4.9	5.5	5.7	5	5.5	4.9	5.1
4.9	5.5	5.2	5.3	5.3	5.9	5.5	5.3
5.8	5.7	4.8	5	4.7	5.3	5.6	5.4
5.4	5.5	5.2	5.6	4.9	5.2	5.2	5.6
5.25	**5.583333**	**5.425**	**5.725**	**5.208333**	**5.591667**	**5.225**	**5.233333**

Subset: Balance

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.6	6.1	6.1	6.3	5.2	5.4	5.1	5
5.3	5.3	5.4	6	5.4	5.2	5.3	5.1
5.9	5.8	6.3	6.4	5.8	5.9	5.6	5.8
5.1	5.6	5.5	6.2	5.3	5.5	5	5.3
5.6	5.7	5.6	5.7	5.5	5.4	5.7	5.5
5	5.5	5.4	5.5	5.1	5.4	5.2	5.6
5.3	5.4	6.2	6.1	6	5.9	5.1	5.3
5.7	6	5.4	5.6	5.9	6.2	5	5.4
5.1	6.1	5.8	5.7	5.3	5.8	4.7	4.8
4.9	5.3	5.3	5.5	4.7	5.3	4.6	5
5.5	5.8	5.1	5.5	4.9	5.5	5.2	5.1
6	5.9	5.5	6.4	5.2	5.1	5.6	5.7
5.416667	**5.708333**	**5.633333**	**5.908333**	**5.358333**	**5.55**	**5.175**	**5.3**

Subset: Speed dynamics

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.1	5.5	5.5	6.1	4.7	5.2	4.7	5.2
5	5.4	5.2	5.6	5.2	5.5	4.9	4.7

5.4	5.3	5.8	6	5.5	5.6	5.2	5
4.9	5	5.3	5.5	5	5.2	4.8	5.1
5.5	5.2	5.5	5.9	5.6	5.8	5.5	5.3
5.3	5.7	5.1	5.4	5.2	5.3	5	4.7
5.1	5.9	5.9	6.3	5.8	6	5.3	4.9
5.8	6.2	5.6	6.2	5.5	6.1	4.8	5.2
5.2	5.4	5.3	5.5	5.1	5.5	4.5	4.6
4.5	5	5.7	5.6	4.5	4.9	4.4	4.5
5.1	5.4	5	5.3	4.7	5.6	4.8	5
5.6	6	5.2	5.7	5	5.3	5.2	5.1
5.208333	**5.5**	**5.425**	**5.758333**	**5.15**	**5.5**	**4.925**	**4.941667**

Component: Expression integration

Subset: Expression quality

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5	5.1	4.9	5	4.5	4.4	4.8	4.6
4.7	4.6	5.5	5.2	4.8	5	5.2	5.4
4.9	4.8	5.5	5.6	5	5.2	5.5	5.2
5.3	5.5	5.8	5.7	5.2	5.5	5	4.8
5.1	5	5.2	5.4	5.5	5.4	5.2	4.9
5.7	5.9	4.9	5	5	5.1	5.7	5.5
5.4	5.5	5.6	5.1	5	5.5	5.4	5.7
6	6.1	6	6.4	4.8	5	5	5.4
5.7	6	5.5	6	4.9	4.7	4.4	4.6
4.9	5.1	5.2	5.4	5.5	4.9	4.8	4.8
5.4	5.3	5.7	5.6	5.2	5	4.3	4.3
5.1	5	4.8	5.3	5.3	5.4	4.4	4.7
5.266667	**5.325**	**5.383333**	**5.475**	**5.058333**	**5.091667**	**4.975**	**4.991667**

Subset: Connectedness of expression with music

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.3	5.2	5	5.2	4.4	4.5	5.2	5.3
5	5.3	5.3	5.5	4.3	4.4	5.3	5
5.3	5.6	5.7	5.8	4.7	5	5	4.9
5.6	5.4	6	6	4.8	5	6	6.1
5	4.8	5	5.5	5.3	5.2	5.3	5.5
4.9	4.9	4.7	4.5	5.1	5	5.6	5.2
4.8	5	5.4	4.9	5.2	5.5	5.1	5
5.5	5.6	5.8	6	4.5	4.3	5.8	5.4
5.4	5.3	5.4	5.6	4.6	4.8	4.7	4.9
5	5.1	5.1	5	4.9	5.1	4.4	4.3
4.9	5	5.6	5.4	5	4.8	4.3	4.2
4.8	5.2	5	5.3	4.8	5	4.2	4.3

5.125	**5.2**	**5.333333**	**5.391667**	**4.8**	**4.883333**	**5.075**	**5.008333**

Subset: Connectedness of expression with flow

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5	5.1	5.5	6	4.6	5	5.2	5.4
5.2	5.4	5	5.5	5	5.1	5	5.1
5.5	5.5	5.4	5.3	4.3	4.4	4.8	4.7
5.1	5.2	5.9	5.6	4.7	4.6	5.7	5.5
4.7	5	4.7	5	5.1	4.9	5.5	4.7
4.5	4.6	5.1	5	4.7	4.8	5.3	5.2
5	4.8	5.6	5.2	4.9	5	5.4	5.5
5.3	5.6	5.3	5.1	4.4	5.1	5.7	5.6
5.1	5	5.1	5	4.3	4.7	4.4	5
4.8	5	4.7	4.6	4.7	4.6	4.2	4.7
5.3	5.7	4.9	5.3	5.2	5.4	4.5	4.9
5.2	5.4	4.6	4.8	5.4	5.7	4.6	4.5
5.058333	**5.191667**	**5.15**	**5.2**	**4.775**	**4.941667**	**5.025**	**5.066667**

Component: Complete Body Involvement

Bharata								Kuchi
Pre				Post				Pre
AC	LS	Energy	T Average	AC	LS	Energy	T Average	AC
5.7	5.2	4.3	5.066667	6.4	6	4.8	5.733333	5.3
4.8	5.3	5.1	5.066667	5.7	5.5	5.8	5.666667	4.9
6.1	5.5	4.9	5.5	6.4	5.6	6.1	6.033333	7.4
5.3	5.8	4.7	5.266667	5.5	6.2	5.3	5.666667	5.8
5.8	6.2	5.7	5.9	5.7	6	6.3	6	6.6
5.5	6	5.3	5.6	5.8	6.5	5.5	5.933333	6
4.4	5.3	4.8	4.833333	5.9	5.7	5.1	5.566667	7.4
4.9	5.5	4.9	5.1	6.1	5.4	5	5.5	4.8
6.7	6.4	5.7	6.266667	6.9	6.6	6.2	6.566667	6.1
7.1	6.8	6.3	6.733333	7.2	7.2	6.6	7	6.4
5.8	6.1	5.5	5.8	6.3	6.9	6	6.4	5.9
6.2	6.5	6.1	6.266667	6.9	7	6.4	6.766667	7.2
			5.616667				**6.069444**	

Component: Complete Body Involvement

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.066667	5.733333	5.566667	5.933333	5.3	6	4.6	4.6
5.066667	5.666667	4.966667	5.466667	4.866667	5.3	5.433333	5.6
5.5	6.033333	6.2	6.166667	5.466667	5.733333	5.3	5.533333
5.266667	5.666667	5.666667	6.366667	5.466667	6.2	6.566667	6.366667
5.9	6	6.6	7	5.466667	5.7	5.233333	5.4
5.6	5.933333	6.066667	6.6	5.533333	5.633333	5.833333	6.1
4.833333	5.566667	6.566667	7.433333	6.566667	6.566667	5.566667	5.733333
5.1	5.5	5.066667	5.866667	6.733333	6.833333	6.433333	6.233333
6.266667	6.566667	6.133333	5.866667	5.433333	5.933333	5.866667	6.1
6.733333	7	6.266667	6.1	4.866667	5.633333	5.4	5.766667
5.8	6.4	5.2	5.966667	6.2	6.4	5.333333	5.433333
6.266667	6.766667	6.166667	6.633333	5.866667	6.333333	5.1	5.133333
5.616667	**6.069444**	**5.872222**	**6.283333**	**5.647222**	**6.022222**	**5.555556**	**5.666667**

Component: Integration of limbs of the body

Bharata								Kuchi
Pre				Post				Pre
CS	SI	IS	T average	CS	SI	IS	T average	CS
4.5	4.2	5.2	4.633333	4.9	4.5	5.8	5.066667	4.1
4.2	3.9	5.8	4.633333	4.4	4.1	6.4	4.966667	4.2
4.7	5	5.7	5.133333	4.5	4.9	6	5.133333	5.4
5.2	5.1	6.2	5.5	5.3	5.2	6.5	5.666667	5.1
5	4.7	5.1	4.933333	4.8	4.9	5.4	5.033333	5.7
5.1	4.5	4.8	4.8	5.5	4.7	5.1	5.1	5
4	3.3	5.4	4.233333	4.3	3.6	5.3	4.4	4.8
4.6	4.2	5.5	4.766667	4.9	4.2	5.6	4.9	5.2

5.3	5.5	5.2	5.333333	6	5.8	5.5	5.766667	5.5
5.2	5.7	6.2	5.7	5.7	6.1	6.7	6.166667	5.3
5	4.6	5.7	5.1	5.3	4.4	6	5.233333	5.2
4.9	5.3	5.3	5.166667	4.7	5.2	5.9	5.266667	5.6
			4.994444				**5.225**	

Component: Integration of limbs of the body

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
4.633333	5.066667	4.566667	5.066667	4.366667	4.6	4.333333	4.333333
4.633333	4.966667	4.433333	4.533333	4.166667	4.4	4.866667	4.833333
5.133333	5.133333	5.333333	5.266667	5.066667	5.233333	4.466667	4.533333
5.5	5.666667	5.4	5.566667	5	5	4.666667	4.766667
4.933333	5.033333	5.533333	5.8	5.166667	5.466667	4.7	4.866667
4.8	5.1	4.866667	5.433333	5.4	5.633333	5.033333	5.166667
4.233333	4.4	5.066667	5.6	5.6	5.966667	5.533333	5.4
4.766667	4.9	5.3	5.433333	5.133333	5.433333	5.633333	5.533333
5.333333	5.766667	5.266667	5.8	4.733333	4.933333	5.066667	5.3
5.7	6.166667	5.566667	5.933333	4.3	4.533333	4.933333	5.133333
5.1	5.233333	5.5	5.9	5.3	5.133333	5.433333	5.566667
5.166667	5.266667	5.533333	5.933333	5.066667	5.433333	4.833333	4.7
4.994444	**5.225**	**5.197222**	**5.522222**	**4.941667**	**5.147222**	**4.958333**	**5.011111**

Component: Lower and Upper limbs coupling and coordination

Bharata						**Kuchi**		
Pre			**Post**			**Pre**		
LL	**UL**	**T average**	**LL**	**UL**	**T average**	**LL**	**UL**	**T average**
5.5	4.9	5.2	5.9	5.3	5.6	5.6	5.4	5.5
5.4	5.2	5.3	5.5	5.7	5.6	5.5	5.1	5.3
5.2	5.5	5.35	5.4	5.9	5.65	5.7	5.5	5.6
6	5.6	5.8	6.2	5.5	5.85	5.9	5.5	5.7
5.5	5.3	5.4	5.9	5.5	5.7	5.3	5.7	5.5
5	5.2	5.1	5.5	5.1	5.3	5	5.2	5.1
5.3	5.8	5.55	5	6	5.5	6	5.8	5.9
5.7	5	5.35	5.4	5.3	5.35	6.1	5.6	5.85
5.1	4.8	4.95	4.9	5	4.95	5.4	5.3	5.35
6.3	5.6	5.95	6.6	6.1	6.35	5.6	5.9	5.75
5.8	5.3	5.55	5.7	5.4	5.55	5.5	5.2	5.35
5.5	5.9	5.7	6.1	5.6	5.85	6	5.6	5.8
		5.433333			**5.604167**			**5.558333**

Component: Lower and Upper limbs coupling and coordination

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.2	5.6	5.5	5.5	4.7	4.85	4.8	4.85
5.3	5.6	5.3	5.7	5.05	5.25	5.2	5.1
5.35	5.65	5.6	5.8	5.35	5.6	5.25	5.3

5.8	5.85	5.7	6.05	5.35	5.25	5.15	5.35
5.4	5.7	5.5	5.9	5.5	5.6	5.7	5.85
5.1	5.3	5.1	5.3	5.4	5.6	4.75	5
5.55	5.5	5.9	6.25	5.3	5.55	5.4	5.1
5.35	5.35	5.85	6.2	5.5	5.35	5.65	5.4
4.95	4.95	5.35	5.5	5.75	6.1	5.2	5.4
5.95	6.35	5.75	6	4.9	5.15	5.65	5.5
5.55	5.55	5.35	5.55	5.1	5.3	4.9	5.05
5.7	5.85	5.8	6	5	5.35	5.45	5.5
5.433333	**5.604167**	**5.558333**	**5.8125**	**5.241667**	**5.4125**	**5.258333**	**5.283333**

Component: Gross Motor movement skills

Bharata								**Kuchi**
Pre				**Post**				**Pre**
Agi	Speed	Balance	T average	**Agi**	Speed	Balance	T average	**Agi**
5.2	5.1	5.6	5.3	5.7	5.5	6.1	5.766667	5.5
5	5	5.3	5.1	5.1	5.4	5.3	5.266667	5.2
5.6	5.4	5.9	5.633333	6	5.3	5.8	5.7	5.9
5.3	4.9	5.1	5.1	6.1	5	5.6	5.566667	5.3
5.7	5.5	5.6	5.6	5.9	5.2	5.7	5.6	5.5
4.9	5.3	5	5.066667	5.3	5.7	5.5	5.5	5.7
5.5	5.1	5.3	5.3	5.8	5.9	5.4	5.7	6
5.1	5.8	5.7	5.533333	5.5	6.2	6	5.9	5.3
4.6	5.2	5.1	4.966667	4.9	5.4	6.1	5.466667	5.5
4.9	4.5	4.9	4.766667	5.5	5	5.3	5.266667	5.2
5.8	5.1	5.5	5.466667	5.7	5.4	5.8	5.633333	4.8
5.4	5.6	6	5.666667	5.5	6	5.9	5.8	5.2
			5.291667				**5.597222**	

Component: Gross Motor movement skills

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.3	5.766667	5.7	6.166667	4.933333	5.3	4.866667	5.133333
5.1	5.266667	5.266667	5.766667	5.266667	5.266667	5.066667	4.866667
5.633333	5.7	6	6.2	5.6	5.7	5.433333	5.366667
5.1	5.566667	5.366667	5.7	5.1	5.366667	5.033333	5.266667
5.6	5.6	5.533333	5.8	5.4	5.633333	5.733333	5.533333
5.066667	5.5	5.4	5.633333	5.266667	5.433333	5.066667	5.2
5.3	5.7	6.033333	6.266667	5.733333	6.033333	5.066667	4.966667
5.533333	5.9	5.433333	5.766667	5.8	6.2	4.966667	5.166667
4.966667	5.466667	5.533333	5.633333	5.133333	5.6	4.7	4.833333
4.766667	5.266667	5.4	5.466667	4.833333	5.366667	4.833333	4.933333
5.466667	5.633333	4.966667	5.266667	4.766667	5.466667	5.2	5.166667
5.666667	5.8	5.3	5.9	5.033333	5.2	5.333333	5.466667
5.291667	**5.597222**	**5.494444**	**5.797222**	**5.238889**	**5.547222**	**5.108333**	**5.158333**

Component: Expression integration

Bharata								Kuchi
Pre				Post				Pre
EQ	EM	EF	T average	EQ	EM	EF	T average	EQ
5	5.3	5	5.1	5.1	5.2	5.1	5.133333	4.9
4.7	5	5.2	4.966667	4.6	5.3	5.4	5.1	5.5
4.9	5.3	5.5	5.233333	4.8	5.6	5.5	5.3	5.5
5.3	5.6	5.1	5.333333	5.5	5.4	5.2	5.366667	5.8
5.1	5	4.7	4.933333	5	4.8	5	4.933333	5.2
5.7	4.9	4.5	5.033333	5.9	4.9	4.6	5.133333	4.9
5.4	4.8	5	5.066667	5.5	5	4.8	5.1	5.6
6	5.5	5.3	5.6	6.1	5.6	5.6	5.766667	6
5.7	5.4	5.1	5.4	6	5.3	5	5.433333	5.5
4.9	5	4.8	4.9	5.1	5.1	5	5.066667	5.2
5.4	4.9	5.3	5.2	5.3	5	5.7	5.333333	5.7
5.1	4.8	5.2	5.033333	5	5.2	5.4	5.2	4.8
			5.15				**5.238889**	

Component: Expression integration

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.1	5.133333	5.133333	5.4	4.5	4.633333	5.066667	5.1
4.966667	5.1	5.266667	5.4	4.7	4.833333	5.166667	5.166667
5.233333	5.3	5.533333	5.566667	4.666667	4.866667	5.1	4.933333
5.333333	5.366667	5.9	5.766667	4.9	5.033333	5.566667	5.466667
4.933333	4.933333	4.966667	5.3	5.3	5.166667	5.333333	5.033333
5.033333	5.133333	4.9	4.833333	4.933333	4.966667	5.533333	5.3
5.066667	5.1	5.533333	5.066667	5.033333	5.333333	5.3	5.4
5.6	5.766667	5.7	5.833333	4.566667	4.8	5.5	5.466667
5.4	5.433333	5.333333	5.533333	4.6	4.733333	4.5	4.833333
4.9	5.066667	5	5	5.033333	4.866667	4.466667	4.6
5.2	5.333333	5.4	5.433333	5.133333	5.066667	4.366667	4.466667
5.033333	5.2	4.8	5.133333	5.166667	5.366667	4.4	4.5
5.15	**5.238889**	**5.288889**	**5.355556**	**4.877778**	**4.972222**	**5.025**	**5.022222**

LS	Energy	T Average	Post AC	LS	Energy	T Average	Bolly Pre AC	LS
6.1	5.3	5.566667	5.6	6.2	6	5.933333	5.5	6.1
5.3	4.7	4.966667	5.8	5.5	5.1	5.466667	4.7	5.2
5.9	5.3	6.2	7.5	5.6	5.4	6.166667	6.2	5.8
5.5	5.7	5.666667	7	5.8	6.3	6.366667	5.7	5.9
7	6.2	6.6	7.1	7	6.9	7	5.6	5.3
6.3	5.9	6.066667	6.2	6.6	7	6.6	5.9	5.5
6.8	5.5	6.566667	7.5	7.7	7.1	7.433333	7.1	6.8
5.1	5.3	5.066667	5.8	6.3	5.5	5.866667	7	6.9
6.7	5.6	6.133333	6	6.1	5.5	5.866667	5.3	6.2
7.2	5.2	6.266667	6.3	6.6	5.4	6.1	4.8	5.3
5.4	4.3	5.2	6.4	6.5	5	5.966667	6.4	6.6
6.4	4.9	6.166667	7.3	7.4	5.2	6.633333	6.2	6.1
		5.872222				**6.283333**		

SI	IS	T average	Post CS	SI	IS	T average	Bolly Pre CS	SI
4.3	5.3	4.566667	4.4	4.7	6.1	5.066667	4.3	4
4	5.1	4.433333	4	4.1	5.5	4.533333	4	3.5
4.6	6	5.333333	5.2	4.4	6.2	5.266667	5.1	4.8
4.8	6.3	5.4	5.4	4.7	6.6	5.566667	5	4.5
5.5	5.4	5.533333	5.9	5.8	5.7	5.8	5.4	4.9
4.4	5.2	4.866667	5.4	5	5.9	5.433333	5.3	5.1
4.7	5.7	5.066667	5.2	5.1	6.5	5.6	5.7	5.5
4.3	6.4	5.3	5.5	4.3	6.5	5.433333	5	4.4

5.2	5.1	5.266667	5.6	5.8	6	5.8	5.1	3.8
5.5	5.9	5.566667	5.5	6.2	6.1	5.933333	4.2	3.7
5.6	5.7	5.5	6	5.4	6.3	5.9	4.9	5.3
4.8	6.2	5.533333	6.1	5	6.7	5.933333	5.4	5
		5.197222				**5.522222**		

Post			**Bolly**					
			Pre			**Post**		
LL	**UL**	**T average**	**LL**	**UL**	**T average**	**LL**	**UL**	**T average**
5.5	5.5	5.5	5	4.4	4.7	5.2	4.5	4.85
5.9	5.5	5.7	5.2	4.9	5.05	5.5	5	5.25
6	5.6	5.8	5.4	5.3	5.35	5.8	5.4	5.6
6.1	6	6.05	5.2	5.5	5.35	5	5.5	5.25
5.5	6.3	5.9	5.6	5.4	5.5	5.3	5.9	5.6
5.2	5.4	5.3	5.1	5.7	5.4	5.2	6	5.6
6.6	5.9	6.25	5.5	5.1	5.3	5.9	5.2	5.55
6.5	5.9	6.2	5.4	5.6	5.5	5.3	5.4	5.35
5.5	5.5	5.5	5.6	5.9	5.75	6	6.2	6.1
5.7	6.3	6	4.8	5	4.9	4.9	5.4	5.15
5.8	5.3	5.55	5.4	4.8	5.1	5.5	5.1	5.3
6.2	5.8	6	4.8	5.2	5	5.3	5.4	5.35
		5.8125			**5.241667**			**5.4125**

Speed	Balance	T average	**Post Agi**	Speed	Balance	T average	**Bolly Pre Agi**	Speed
5.5	6.1	5.7	6.1	6.1	6.3	6.166667	4.9	4.7
5.2	5.4	5.266667	5.7	5.6	6	5.766667	5.2	5.2
5.8	6.3	6	6.2	6	6.4	6.2	5.5	5.5
5.3	5.5	5.366667	5.4	5.5	6.2	5.7	5	5
5.5	5.6	5.533333	5.8	5.9	5.7	5.8	5.1	5.6
5.1	5.4	5.4	6	5.4	5.5	5.633333	5.5	5.2
5.9	6.2	6.033333	6.4	6.3	6.1	6.266667	5.4	5.8
5.6	5.4	5.433333	5.5	6.2	5.6	5.766667	6	5.5
5.3	5.8	5.533333	5.7	5.5	5.7	5.633333	5	5.1
5.7	5.3	5.4	5.3	5.6	5.5	5.466667	5.3	4.5
5	5.1	4.966667	5	5.3	5.5	5.266667	4.7	4.7
5.2	5.5	5.3	5.6	5.7	6.4	5.9	4.9	5
		5.494444				**5.797222**		

EM	EF	T average	Post EQ	EM	EF	T average	Bolly Pre EQ	EM
5	5.5	5.133333	5	5.2	6	5.4	4.5	4.4
5.3	5	5.266667	5.2	5.5	5.5	5.4	4.8	4.3
5.7	5.4	5.533333	5.6	5.8	5.3	5.566667	5	4.7
6	5.9	5.9	5.7	6	5.6	5.766667	5.2	4.8
5	4.7	4.966667	5.4	5.5	5	5.3	5.5	5.3
4.7	5.1	4.9	5	4.5	5	4.833333	5	5.1
5.4	5.6	5.533333	5.1	4.9	5.2	5.066667	5	5.2
5.8	5.3	5.7	6.4	6	5.1	5.833333	4.8	4.5
5.4	5.1	5.333333	6	5.6	5	5.533333	4.9	4.6
5.1	4.7	5	5.4	5	4.6	5	5.5	4.9
5.6	4.9	5.4	5.6	5.4	5.3	5.433333	5.2	5
5	4.6	4.8	5.3	5.3	4.8	5.133333	5.3	4.8
		5.288889				**5.355556**		

		Post				Control Pre		
Energy	**T Average**	**AC**	**LS**	**Energy**	**T Average**	**AC**	**LS**	**Energy**
4.3	5.3	6.2	6.5	5.3	6	4.6	5	4.2
4.7	4.866667	5.5	5.4	5	5.3	6.2	5.7	4.4
4.4	5.466667	6.1	6	5.1	5.733333	5.8	5.4	4.7
4.8	5.466667	6.2	6.4	6	6.2	7.2	6.9	5.6
5.5	5.466667	5.5	5.4	6.2	5.7	4.9	5.3	5.5
5.2	5.533333	5.8	5.6	5.5	5.633333	6.3	6	5.2
5.8	6.566667	7.5	6.6	5.6	6.566667	5.8	6.1	4.8
6.3	6.733333	7.3	7.3	5.9	6.833333	6.7	6.6	6
4.8	5.433333	5.8	7	5	5.933333	5.9	6.4	5.3
4.5	4.866667	5.5	6.4	5	5.633333	5.5	5.9	4.8
5.6	6.2	6.7	6.9	5.6	6.4	6.1	5.5	4.4
5.3	5.866667	6.6	6.1	6.3	6.333333	5.7	5.4	4.2
	5.647222				**6.022222**			

		Post				Control Pre		
IS	**T average**	**CS**	**SI**	**IS**	**T average**	**CS**	**SI**	**IS**
4.8	4.366667	4.5	4.3	5	4.6	3.9	4.2	4.9
5	4.166667	4.3	3.8	5.1	4.4	5	4.4	5.2
5.3	5.066667	4.8	5.4	5.5	5.233333	4.6	3.8	5
5.5	5	4.9	4.3	5.8	5	5.2	3.9	4.9
5.2	5.166667	5.3	5.7	5.4	5.466667	4.4	4.3	5.4
5.8	5.4	5.9	5	6	5.633333	4.9	5	5.2
5.6	5.6	6.3	5.3	6.3	5.966667	5	5.7	5.9
6	5.133333	5.5	4.5	6.3	5.433333	5.6	5.3	6

5.3	4.733333	5	4	5.8	4.933333	5.2	4.6	5.4
5	4.3	4.1	4.1	5.4	4.533333	4.8	4.7	5.3
5.7	5.3	4.8	4.8	5.8	5.133333	5.2	5.4	5.7
4.8	5.066667	6.2	4.9	5.2	5.433333	4.7	5	4.8
	4.941667				**5.147222**			

Control

Pre			**Post**		
LL	**UL**	**T average**	**LL**	**UL**	**T average**
5.1	4.5	4.8	5.3	4.4	4.85
5.5	4.9	5.2	5.6	4.6	5.1
5.3	5.2	5.25	5.2	5.4	5.3
5	5.3	5.15	5.2	5.5	5.35
5.5	5.9	5.7	5.9	5.8	5.85
4.9	4.6	4.75	5	5	5
5.6	5.2	5.4	5.2	5	5.1
5.8	5.5	5.65	5.5	5.3	5.4
5.1	5.3	5.2	5.3	5.5	5.4
5.5	5.8	5.65	5.4	5.6	5.5
5	4.8	4.9	5.1	5	5.05
5.6	5.3	5.45	5.6	5.4	5.5
		5.258333			**5.283333**

		Post				**Control Pre**		
Balance	T average	**Agi**	Speed	Balance	T average	**Agi**	Speed	Balance
5.2	4.933333	5.3	5.2	5.4	5.3	4.8	4.7	5.1
5.4	5.266667	5.1	5.5	5.2	5.266667	5	4.9	5.3
5.8	5.6	5.6	5.6	5.9	5.7	5.5	5.2	5.6
5.3	5.1	5.4	5.2	5.5	5.366667	5.3	4.8	5
5.5	5.4	5.7	5.8	5.4	5.633333	6	5.5	5.7
5.1	5.266667	5.6	5.3	5.4	5.433333	5	5	5.2
6	5.733333	6.2	6	5.9	6.033333	4.8	5.3	5.1
5.9	5.8	6.3	6.1	6.2	6.2	5.1	4.8	5
5.3	5.133333	5.5	5.5	5.8	5.6	4.9	4.5	4.7
4.7	4.833333	5.9	4.9	5.3	5.366667	5.5	4.4	4.6
4.9	4.766667	5.3	5.6	5.5	5.466667	5.6	4.8	5.2
5.2	5.033333	5.2	5.3	5.1	5.2	5.2	5.2	5.6
	5.238889				**5.547222**			

		Post				Control Pre		
EF	**T average**	**EQ**	**EM**	**EF**	**T average**	**EQ**	**EM**	**EF**
4.6	4.5	4.4	4.5	5	4.633333	4.8	5.2	5.2
5	4.7	5	4.4	5.1	4.833333	5.2	5.3	5
4.3	4.666667	5.2	5	4.4	4.866667	5.5	5	4.8
4.7	4.9	5.5	5	4.6	5.033333	5	6	5.7
5.1	5.3	5.4	5.2	4.9	5.166667	5.2	5.3	5.5
4.7	4.933333	5.1	5	4.8	4.966667	5.7	5.6	5.3
4.9	5.033333	5.5	5.5	5	5.333333	5.4	5.1	5.4
4.4	4.566667	5	4.3	5.1	4.8	5	5.8	5.7
4.3	4.6	4.7	4.8	4.7	4.733333	4.4	4.7	4.4
4.7	5.033333	4.9	5.1	4.6	4.866667	4.8	4.4	4.2
5.2	5.133333	5	4.8	5.4	5.066667	4.3	4.3	4.5
5.4	5.166667	5.4	5	5.7	5.366667	4.4	4.2	4.6
	4.877778				**4.972222**			

T Average	Post AC	LS	Energy	T Average
4.6	4.5	4.9	4.4	4.6
5.433333	6	6	4.8	5.6
5.3	6.1	5.5	5	5.533333
6.566667	6.9	6.7	5.5	6.366667
5.233333	5.3	5.5	5.4	5.4
5.833333	6.6	6.2	5.5	6.1
5.566667	6.2	6	5	5.733333
6.433333	6.4	6.5	5.8	6.233333
5.866667	6.1	6.8	5.4	6.1
5.4	5.8	6.3	5.2	5.766667
5.333333	6.2	5.8	4.3	5.433333
5.1	5.4	5.3	4.7	5.133333
5.555556				**5.666667**

T average	Post CS	SI	IS	T average
4.333333	4.1	3.8	5.1	4.333333
4.866667	5.2	4.3	5	4.833333
4.466667	4.5	4	5.1	4.533333
4.666667	4.8	4.2	5.3	4.766667
4.7	4.6	4.7	5.3	4.866667
5.033333	5.3	5.2	5	5.166667
5.533333	5.1	5.4	5.7	5.4
5.633333	5.5	5	6.1	5.533333

5.066667	5.5	4.4	6	5.3
4.933333	5	4.9	5.5	5.133333
5.433333	5.8	5.5	5.4	5.566667
4.833333	4.2	5.2	4.7	4.7
4.958333				**5.011111**

	Post			
T average	**Agi**	Speed	Balance	T average
4.866667	5.2	5.2	5	5.133333
5.066667	4.8	4.7	5.1	4.866667
5.433333	5.3	5	5.8	5.366667
5.033333	5.4	5.1	5.3	5.266667
5.733333	5.8	5.3	5.5	5.533333
5.066667	5.3	4.7	5.6	5.2
5.066667	4.7	4.9	5.3	4.966667
4.966667	4.9	5.2	5.4	5.166667
4.7	5.1	4.6	4.8	4.833333
4.833333	5.3	4.5	5	4.933333
5.2	5.4	5	5.1	5.166667
5.333333	5.6	5.1	5.7	5.466667
5.108333				**5.158333**

T average	Post EQ	EM	EF	T average
5.066667	4.6	5.3	5.4	5.1
5.166667	5.4	5	5.1	5.166667
5.1	5.2	4.9	4.7	4.933333
5.566667	4.8	6.1	5.5	5.466667
5.333333	4.9	5.5	4.7	5.033333
5.533333	5.5	5.2	5.2	5.3
5.3	5.7	5	5.5	5.4
5.5	5.4	5.4	5.6	5.466667
4.5	4.6	4.9	5	4.833333
4.466667	4.8	4.3	4.7	4.6
4.366667	4.3	4.2	4.9	4.466667
4.4	4.7	4.3	4.5	4.5
5.025				**5.022222**

Total dancing performance

Bharata

Pre						**Post**		
CBI	**IL**	**LU**	**GM**	**EI**	**T average**	**CBI**	**IL**	**LU**
5.066667	4.633333	5.2	5.3	5.1	5.06	5.733333	5.066667	5.6
5.066667	4.633333	5.3	5.1	4.966667	5.013333	5.666667	4.966667	5.6
5.5	5.133333	5.35	5.633333	5.233333	5.37	6.033333	5.133333	5.65
5.266667	5.5	5.8	5.1	5.333333	5.4	5.666667	5.666667	5.85
5.9	4.933333	5.4	5.6	4.933333	5.353333	6	5.033333	5.7
5.6	4.8	5.1	5.066667	5.033333	5.12	5.933333	5.1	5.3
4.833333	4.233333	5.55	5.3	5.066667	4.996667	5.566667	4.4	5.5
5.1	4.766667	5.35	5.533333	5.6	5.27	5.5	4.9	5.35
6.266667	5.333333	4.95	4.966667	5.4	5.383333	6.566667	5.766667	4.95
6.733333	5.7	5.95	4.766667	4.9	5.61	7	6.166667	6.35
5.8	5.1	5.55	5.466667	5.2	5.423333	6.4	5.233333	5.55
6.266667	5.166667	5.7	5.666667	5.033333	5.566667	6.766667	5.266667	5.85
					5.297222			

Total dancing performance

Bharata		***Kuchi***		**Bolly**		**Con**	
Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
5.06	5.46	5.293333	5.613333	4.76	5.076667	4.733333	4.803333
5.013333	5.32	5.046667	5.373333	4.81	5.01	5.146667	5.113333
5.37	5.563333	5.733333	5.8	5.23	5.426667	5.11	5.133333
5.4	5.623333	5.606667	5.89	5.163333	5.37	5.396667	5.443333
5.353333	5.453333	5.626667	5.96	5.366667	5.513333	5.34	5.336667
5.12	5.393333	5.266667	5.56	5.306667	5.453333	5.243333	5.353333
4.996667	5.253333	5.82	6.123333	5.646667	5.89	5.373333	5.32
5.27	5.483333	5.47	5.82	5.546667	5.723333	5.636667	5.56
5.383333	5.636667	5.523333	5.666667	5.13	5.46	5.066667	5.293333
5.61	5.97	5.596667	5.7	4.786667	5.11	5.056667	5.186667
5.423333	5.63	5.283333	5.623333	5.3	5.473333	5.046667	5.136667
5.566667	5.776667	5.52	5.92	5.226667	5.536667	5.023333	5.06
5.297222	**5.546944**	**5.482222**	**5.754167**	**5.189444**	**5.420278**	**5.181111**	**5.228333**

GM	EI	T average	Kuchi Pre CBI	IL	LU	GM	EI	T average
5.766667	5.133333	5.46	5.566667	4.566667	5.5	5.7	5.133333	5.293333
5.266667	5.1	5.32	4.966667	4.433333	5.3	5.266667	5.266667	5.046667
5.7	5.3	5.563333	6.2	5.333333	5.6	6	5.533333	5.733333
5.566667	5.366667	5.623333	5.666667	5.4	5.7	5.366667	5.9	5.606667
5.6	4.933333	5.453333	6.6	5.533333	5.5	5.533333	4.966667	5.626667
5.5	5.133333	5.393333	6.066667	4.866667	5.1	5.4	4.9	5.266667
5.7	5.1	5.253333	6.566667	5.066667	5.9	6.033333	5.533333	5.82
5.9	5.766667	5.483333	5.066667	5.3	5.85	5.433333	5.7	5.47
5.466667	5.433333	5.636667	6.133333	5.266667	5.35	5.533333	5.333333	5.523333
5.266667	5.066667	5.97	6.266667	5.566667	5.75	5.4	5	5.596667
5.633333	5.333333	5.63	5.2	5.5	5.35	4.966667	5.4	5.283333
5.8	5.2	5.776667	6.166667	5.533333	5.8	5.3	4.8	5.52
		5.546944						**5.482222**

Post						Bolly Pre		
CBI	**IL**	**LU**	**GM**	**EI**	**T average**	**CBI**	**IL**	**LU**
5.933333	5.066667	5.5	6.166667	5.4	5.613333	5.3	4.366667	4.7
5.466667	4.533333	5.7	5.766667	5.4	5.373333	4.866667	4.166667	5.05
6.166667	5.266667	5.8	6.2	5.566667	5.8	5.466667	5.066667	5.35
6.366667	5.566667	6.05	5.7	5.766667	5.89	5.466667	5	5.35
7	5.8	5.9	5.8	5.3	5.96	5.466667	5.166667	5.5
6.6	5.433333	5.3	5.633333	4.833333	5.56	5.533333	5.4	5.4
7.433333	5.6	6.25	6.266667	5.066667	6.123333	6.566667	5.6	5.3
5.866667	5.433333	6.2	5.766667	5.833333	5.82	6.733333	5.133333	5.5
5.866667	5.8	5.5	5.633333	5.533333	5.666667	5.433333	4.733333	5.75
6.1	5.933333	6	5.466667	5	5.7	4.866667	4.3	4.9
5.966667	5.9	5.55	5.266667	5.433333	5.623333	6.2	5.3	5.1
6.633333	5.933333	6	5.9	5.133333	5.92	5.866667	5.066667	5
					5.754167			

			Post					
GM	**EI**	**T average**	**CBI**	**IL**	**LU**	**GM**	**EI**	**T average**
4.933333	4.5	4.76	6	4.6	4.85	5.3	4.633333	5.076667
5.266667	4.7	4.81	5.3	4.4	5.25	5.266667	4.833333	5.01
5.6	4.666667	5.23	5.733333	5.233333	5.6	5.7	4.866667	5.426667
5.1	4.9	5.163333	6.2	5	5.25	5.366667	5.033333	5.37
5.4	5.3	5.366667	5.7	5.466667	5.6	5.633333	5.166667	5.513333
5.266667	4.933333	5.306667	5.633333	5.633333	5.6	5.433333	4.966667	5.453333
5.733333	5.033333	5.646667	6.566667	5.966667	5.55	6.033333	5.333333	5.89
5.8	4.566667	5.546667	6.833333	5.433333	5.35	6.2	4.8	5.723333
5.133333	4.6	5.13	5.933333	4.933333	6.1	5.6	4.733333	5.46
4.833333	5.033333	4.786667	5.633333	4.533333	5.15	5.366667	4.866667	5.11
4.766667	5.133333	5.3	6.4	5.133333	5.3	5.466667	5.066667	5.473333
5.033333	5.166667	5.226667	6.333333	5.433333	5.35	5.2	5.366667	5.536667
		5.189444						**5.420278**

Con										
Pre							Post			
CBI	IL	LU	GM	EI	T average		CBI	IL	LU	
4.6	4.333333	4.8	4.866667	5.066667	4.733333		4.6	4.333333	4.85	
5.433333	4.866667	5.2	5.066667	5.166667	5.146667		5.6	4.833333	5.1	
5.3	4.466667	5.25	5.433333	5.1	5.11		5.533333	4.533333	5.3	
6.566667	4.666667	5.15	5.033333	5.566667	5.396667		6.366667	4.766667	5.35	
5.233333	4.7	5.7	5.733333	5.333333	5.34		5.4	4.866667	5.85	
5.833333	5.033333	4.75	5.066667	5.533333	5.243333		6.1	5.166667	5	
5.566667	5.533333	5.4	5.066667	5.3	5.373333		5.733333	5.4	5.1	
6.433333	5.633333	5.65	4.966667	5.5	5.636667		6.233333	5.533333	5.4	
5.866667	5.066667	5.2	4.7	4.5	5.066667		6.1	5.3	5.4	
5.4	4.933333	5.65	4.833333	4.466667	5.056667		5.766667	5.133333	5.5	
5.333333	5.433333	4.9	5.2	4.366667	5.046667		5.433333	5.566667	5.05	
5.1	4.833333	5.45	5.333333	4.4	5.023333		5.133333	4.7	5.5	
					5.181111					

GM	EI	T average
5.133333	5.1	4.803333
4.866667	5.166667	5.113333
5.366667	4.933333	5.133333
5.266667	5.466667	5.443333
5.533333	5.033333	5.336667
5.2	5.3	5.353333
4.966667	5.4	5.32
5.166667	5.466667	5.56
4.833333	4.833333	5.293333
4.933333	4.6	5.186667
5.166667	4.466667	5.136667
5.466667	4.5	5.06
		5.228333

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