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Agility and balance in ballet dancer a observational study

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Abstract
Ballet is a form of Theatrical entertainment in which dancers, usually accompanied by music, tell a story or express a mood through their movements. The technique of ballet is elaborate and requires many years of training. Balance is a key factor when doing ballet dance. While often slow and graceful, ballet has its swift moments as well. Agility skill is defined in many ways most of them sound like „the quick movement of the body in response to a stimulus "as well as„ the ability to rapidly change the movement direction "or the ability to start and stop quickly". Motor skills that affect the agility are balance, coordination, explosive strength and flexibility. A simple pirouette (practice on one foot) is executing balance while you are turning. Performing a ballet dance routine takes a great amount of agility.
Aim: To assess agility and balance in Ballet Dancers.
Objective: To assess agility in ballet dancers. To assess balance in ballet dancers.
Methodology: Observational study done on 50 ballet dancers, Dancers who are dancing more than one year, selected by purposive sampling. They were assessed on Stork balance stand test, Modified bass test of dynamic balance, Hexagonal agility test.
Data Analysis and Result: Data analyzed through non-parametric statistical test. In modified bass dynamic balance test, dancers were successfully jumped (68%) on right side and (40%) on left side. In hexagonal agility test, dancers were successfully jumped (68%) on right side and (30%) on left side.In stork balance static test, the dancers scored 12% average, 33% fair and 22% poor on right toe standing and 4% average, 66% fair and 30% poor on left toe standing.
Conclusion: Thus in the above study, we concluded that above group had good static and dynamic balance but agility was good to fair in ballet dancers.

Keywords: Ballet dancer, stork balance stand test, modified bass test of dynamic balance, hexagonal agility test, balance, agility

1. Introduction
Ballet is a form of Theatrical entertainment in which dancers, usually accompanied by music, tell a story or express a mood through their movements. The technique of ballet is elaborate and requires many years of training [1].
Ballet dance involves the performance of complex movement that requires high level of motor skills and good postural control. Ballet dance demands of exceptional balance, co-ordination and agility [36].
Agility skill is defined in many ways most of them sound like the quick movement of the body in response to a stimulus as well as the ability to rapidly change the movement direction or the ability to start and stop quickly. Motor skills that affect the agility are balance, coordination, explosive strength and flexibility [5].
Defining the balance skill scientist described the static balance as "the ability to keep a good base and a steady position with less moves" and the dynamic balance as "the ability to execute a movement while keeping a stable position of the body. Balance is a key factor when doing ballet dance [5].
A simple pirouette (practice on one foot) is executing balance while you are turning. Not only your physical strength, alignment and pulling up are the only keys to a pirouette, but disciplining your mind, concentrating and focusing are a major part of balance. The regulation of posture is a process that is not completely automatic but which requires a certain amount of attentional resources [21, 22].

Ballet dancers need pointe work (standing on toe of both the limb) turn-out of the legs, balance, symmetry, speed, off balance feel (one leg stance), great range of motion and pointe shoes but also bare foot. Increased agility while often slow and graceful, ballet has its swift moments as well [2].
Performing a ballet dance routine takes a great amount of agility. Dance classes are useful for all athletes trying to gain more agility. The body need muscular strength because it contributes to agility helps control the weight of the body motion and helps the body maneuver quickly [35].
Children typically begin ballet training between the age of 5 to 8 years old though which they learn basic dance techniques. Training allows new dancers to develop flexibility, strength and mobility [35].
Balance skills and agility are motor qualities that are more easily learned and developed at young age with specific training and during the appropriate age level.
Agility is not just about the speed with which an individual can change direction. Dancers requires strength, control and coordination while you move in all different directions, jump, twist and turn [2].
Now a days physical demands placed on dancers from current choreography and performance schedules make their physiology and fitness just as important as skill development. However, even at the height of their professional careers, dancers' aerobic power, muscular strength, muscular balance, bone and joint integrity are the 'Achilles heels' of the dance-only selection and training system [37].

2. Need of Study
Ballet dance demands of exceptional balance, co-ordination and agility. Agility is mainly checked in athletics rather than dancers [5].
Agility movements involves perceptual component like decision making and anticipation in all processes of dance. [18]. Speed and agility skill involves moving the body very quickly, as fast as possible, but in agility skill we add the attribute of changing direction that is very important in ballet dance. [18]Researches have been done on balance in ballet dancers. Ttherefore this study would assessing static, dynamic balance and agility in ballet dancers.

3. Aim
To assess agility and balance in Ballet Dancers.

4. Objectives
To assess agility in ballet dancers by Hexagonal agility test.
To assess balance in ballet dancers by Stork balance stand test and Modified bass test of dynamic balance.

5. Methodology
Observational study done on 50 ballet dancers, Dancers who are dancing more than one year with the age group of 8 to 15 years of age, selected by purposive sampling. Exclusion Criteria: Any recent lower limb musculoskeletal injuries and any neurological/systemic disorders.

6. Materials
Stop watch, Measuring tape, Pen, Paper and Sticking tape.

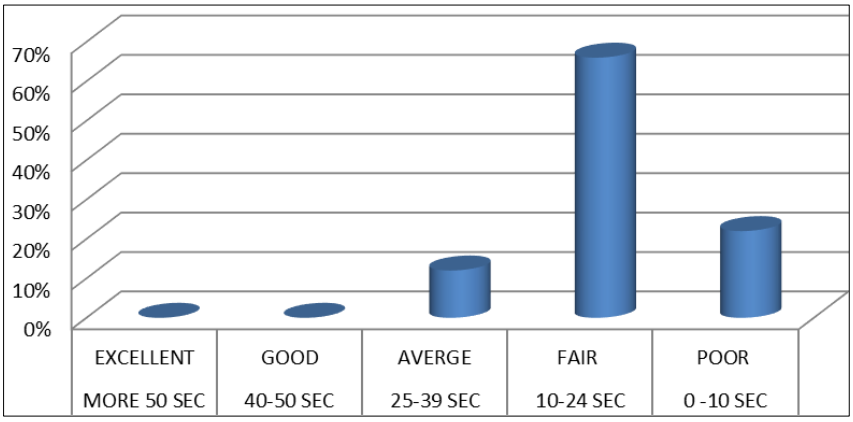
7. Outcome Measure
Stork balance stand test for static balance, Modified bass test of dynamic balance and Hexagonal agility test for agility.

8. Procedure
Ethical approval was taken.The participants were selected according to inclusion and exclusion criteria by purposive sampling method. Written consent was taken from the participants and dance teachers. Testing procedure was explained as well as demonstrated to the dancers. Participants were given 2 trails for each tests. The data was collected followed by which the statistical analysis was done.

9. Data Analysis and Result
Data analyzed through non-parametric statistical test. Chi square test were used to compare right and left side of the participants.

Table 1: Stork balance stand test standing on right toe [4, 5]

Stork Balance Test - Standing On Right Toe				
More 50 Sec	**40-50 Sec**	**25-39 Sec**	**10-24 Sec**	**0 -10 Sec**
Excellent	**Good**	**Average**	**Fair**	**Poor**
0%	0%	12%	66%	22%
0	0	6	33	11

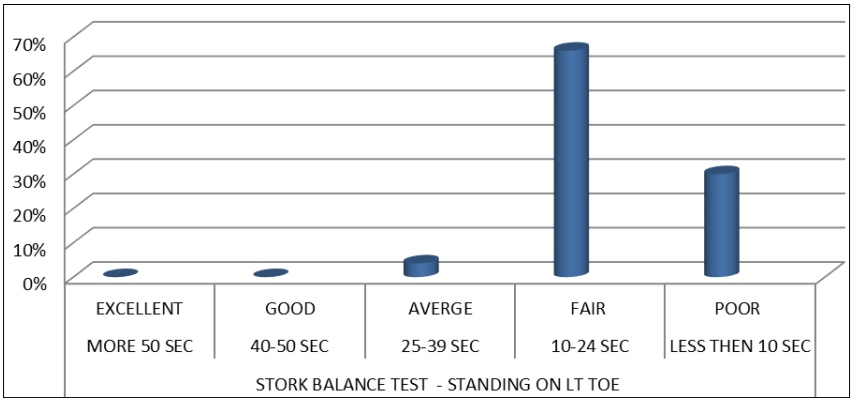


Graph 1: Stork Balance Test of Right Toe

In above graph no.1 shows on "standing on right toe" in Stork balance stand test, dancers scored were 12% average, 33% fair and 22% poor.

Table 2: Stork balance stand test standing on left toe [4, 5]

Stork Balance Test - Standing on Left Toe				
More 50 Sec	**40-50 Sec**	**25-39 Sec**	**10-24 Sec**	**Less Than 10 Sec**
Excellent	**Good**	**Average**	**Fair**	**Poor**
0%	0%	4%	66%	30%
0	0	4	33	15

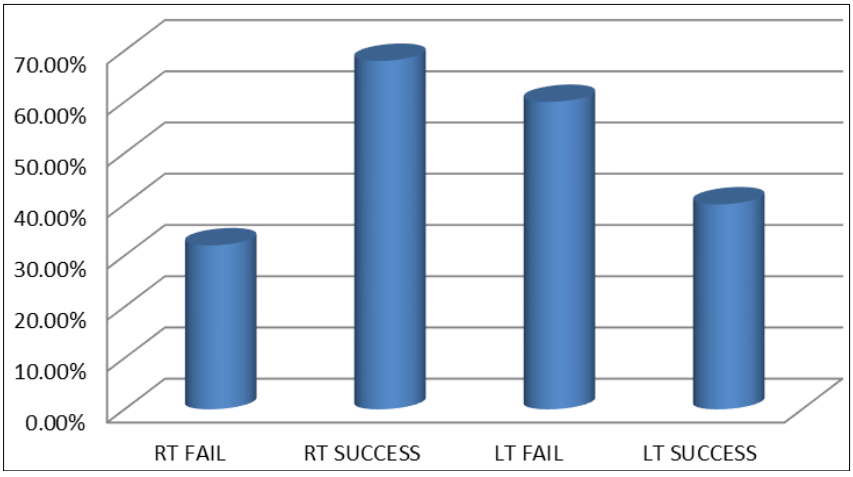


Graph 2: Stork Balance Test of Left Toe

In above graph no.2 shows on "standing on left toe" in Stork balance stand test, dancers scored were 4% average, 66% fair and 30% poor.

Table 3: Modified bass test of dynamic balance [5, 6].

Dynamic Balance Test			
RT Fail	**RT Success**	**LT Fail**	**LT Success**
32.00%	68%	60%	40.00%
16	34	30	20



Graph 3: Dynamic balance test

In above graph no.3: Dancers were successfully jumped on 68% right limb and 40% on left limb On Modified Bass Test of Dynamic Balance.

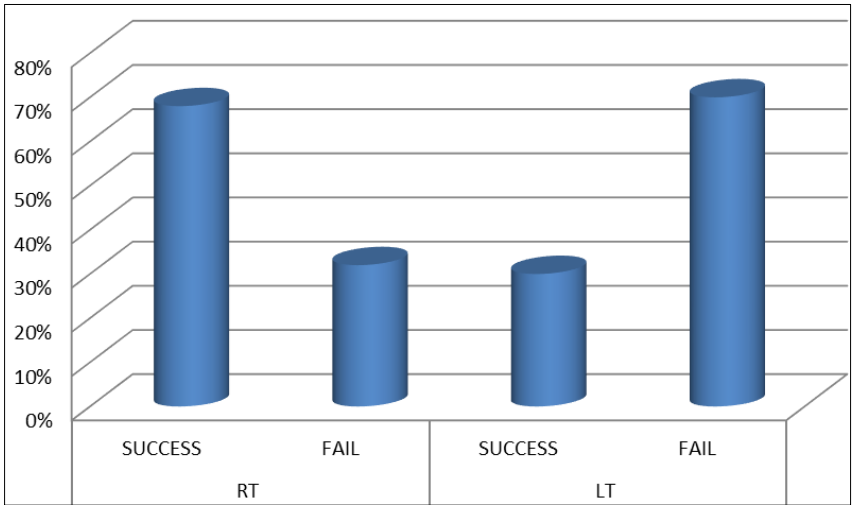
Table 4: Comparing success and fail of right and left side of the participants

Modified Bass Dynamic Balance Test				**Chi Square Test**	**P Value**
Success (Right)	16	Fail (Right)	34	6.804 With 1 Degree Of Freedom	P = 0.009
Success (Left)	30	Fail (Left)	20		

The above table no.4 shows that in modified bass dynamic balance test with the help of chi square test comparing left and right side of the participants. P value is 0.009 which is considered significant.

Table 5: Hexagon agility test [5, 8, 9]

Hexagonal Agility Test			
RT		LT	
Success	Fail	Success	Fail
68%	32%	30%	70%



Graph 4: Hexagonal Agility Test

In above graph no 4: We see that 68% on right side and 30% on left side were successful jumping in Hexagonal agility test.

Table 6: Comparing success and fail of right and left side of the participants.

Hexagonal Agility Test				Chi Square Test	P Value
Success (Right)	34	Fail (Right)	16	12.965 With 1 Degree of Freedom	P = 0.00
Success (Left)	15	Fail (Left)	35		

The above table no.6 shows that in hexagonal agility test with the help of chi square test comparing left and right side of the participants. P value is 0.00 which is extremely considered significant.

Comparing right and left side of the dominant and non-side of the participants

Table 7: Stork balance stand test

Static Balance Test	Dominant Side	No. of Participants	Average	Fair	Poor
Right Side	Right Dominant	43	12%	63%	26%
	Left Dominant	7	14.20%	85.70%	0%
Left Side	Right Dominant	43	12%	63%	26%
	Left Dominant	7	14.20%	85.70%	0%

In table no.7 According to the statistical analysis there were no significant change was found in static balance for both the dominant participants.

Table 8: Modified bass dynamic test

Dynamic Balance Test	Dominant Participants	No. of Participants	Success	Fail	Degree Of Freedom	P Value
Right Side	Right Dominant	43	62%	37%	2.311	0.128
	Left Dominant	7	100%	0%		
Left Side	Right Dominant	43	30%	69.70%	9.475	0.002
	Left Dominant	7	100%	0%		

In table no.8 According to the statistical analysis of above study table we can see that the left dominant participants have better dynamic balance on both side than right dominant participants.

Table 9: Hexagonal agility test

Hexagonal agility test	Dominant participants	no. of participants	success	fail	Degree of freedom	P value
right side	right dominant	43	63%	37%	2.311	0.128
	left dominant	7	100%	0%		
left side	right dominant	43	23%	77%	4.556	0.033
	left dominant	7	71%	28.5%		

In table no.9: According to the statistical analysis of above table we can see that left dominant participants have better agility than right dominant participants.

10. Discussion

The above study included total number of 50 girl's participants with the mean age group of 9 ± 1.4 years. There were three test used in this study which included.

1. Stork Balance Stand Test for Static Balance
2. Modified Bass Test for Dynamic Balance
3. Hexagonal Agility Test To For Agility.

Only girls were participated in this study.

In stork balance stand test, dancers scored 12% average, 33% fair and 22% poor on right toe standing and 4% average, 66% fair and 30% poor on left toe standing.

Information regarding the balance of ballet dancers is of great importance, as they are considered models of great postural control [1, 5].

Balance is also important from a large number and complex group of factors information from sensory system (visual system, somatosensory system and vestibular system) strength and range of motion that helps protect from injuries and execute complex and specific action [18].

The center of pressure in the anterior-posterior and medial-lateral directions are similar for both dominant side of the participants [19]. Ballet dancers should be more focus on both the legs and frontal place control (medial-lateral direction) should be integrated to ballet training program [19].

Therefore No significant difference was found in both the dominance. For maintaining a stable standing posture against gravity force, the body alignment should be controlled appropriately and Centre of pressure position should be kept within the base of support [29].

In modified bass test for dynamic balance, dancers were successfully jumped 68% on right and 40% on left limb. P value 0.009 which considered as significant.

According to statistical analysis above study shows that right side have more dynamic balance than left side of the body. The dominant leg can transmit run-up velocity into the vertical velocity at take-off phase to jump high compared with the non-dominant leg [30].

Dynamic posture control can be defined as the ability to maintain the center of mass within the base of support while the body is subjected to internal or external perturbations that are anticipated or not [19, 21, 22].

The constant integration of afference from peripheral sensory system (vision, vestibular and proprioceptive) by the central nervous system is necessary to achieve optimal postural control [19, 21, 22].

Strength demands are most likely greater when performing dynamic tasks compared with static tasks [23]. Closed kinetic chain motion at the ankle, knee, and hip must be adequately controlled by the lower extremity musculature in order to execute the dynamic balance and hexagonal agility test [23].

Conversely, maintaining single-leg stance while standing on a stable platform places relatively small strength demands on the lower extremity musculature. Second, range-of-motion requirements are greater when performing dynamic tasks such as the dynamic balance compared with quiet standing tasks [23].

In a balance task during quiet standing, apprehension may be substantially less because a subject's limits of stability are rarely challenged [23].

The postural stability of the dominant side for mobilizing or dynamic functions is greater than those of the non-dominant side [29].

In hexagonal agility test, dancers were successfully jumped 68% right and 30% left side. P value 0.001 which is extremely significant. The hexagon test shows excellent reliability for measuring agility, which supports its use as a tool to assess athletic performance and lower extremity agility [21].

When we speak about agility in ballet dancers we not only refer cognitive component that are involved in different task like (unipodal position, turning, twisting position) that are more differently than more complex and unpredictable tasks in ballet dancers [18]. Agility movements involves perceptual component like decision making and anticipation in all processes of dance [18].

Speed and agility skill involves moving the body very quickly, as fast as possible, but in agility skill we add the attribute of changing direction that is very important in ballet dance [18].

The dominant eye permits a priority treatment of the information on its visual field and thus allows faster reaction times on dominant side. The supporting leg permits more reactive strength and a better motor control of push-off actions, thus allows turning faster on the opposite side [32].

Therefore each dancers had a weak side and a strong side when she performed a 180° rotation, which is why this ability must be trained more on non-dominant side [32].

Comparing static, dynamic balance and agility of right and left dominant participants

It is possible that the right-side dominance for postural stability in dynamic balance condition is related to the functional lateral dominance between the left and right hemispheres. With regard to the laterality of the cerebral hemispheres, functional differences between the hemispheres are not found at low processing levels, but are clearly found at higher processing levels [24].

The central nervous system for postural control is divided into reflex- and situation-dependent adaptation [25]. The former is composed primarily of the brainstem, spinal cord and cerebellum and is closely involved in the control of static balance. The latter also incorporates the diencephalon, basal ganglia and cerebral cortex and is involved in the control of dynamic balance [26, 27].

The right hemisphere is dominantly involved in spatial perception and attentional function directed to somatosensory information, whereas the left hemisphere is dominantly involved in the cognition of sound duration and continuity and rhythm [28].

During periodic floor oscillation, the anticipation of the regular postural disturbance is essential. Thus, the left hemisphere may play a relatively important role [33].

The familial left-handed show greater recovery of functioning following unilateral cerebral insult than do non-familial right-handed and non-familial left-handed. Both behavioural and clinical lesion studies indicate systematic differences in lateralization of cerebral function between the right- and left-handed and the familial and non-familial left-handed. A classification of handedness and lateralization of cerebral function is suggested [33].

In stork standing test for static balance, comparing right and left dominance right side (toe). There were 12% average, 63% fair, 26% poor of right dominant participants. Whereas

standing on right toe 14.20% average, 85% fair of left dominant participants.While comparing right side of both the dominant participants'. There were 12% average, 63% fair and 26% poor of left dominant participants. Whereas standing on left toe 14.20% average, 85% fair of left side of both the dominant participants.

Training the dynamic equilibrium of ballet dancer is mainly done in upright position and on frontal plane [21, 22].

The center of pressure in the anterior-posterior and medial-lateral directions are similar for both dominant participants [19]. Ballet dance involves the performance of complex movements that require high level of motor skills and good posture control [19].

According to the statistical analysis there were no significant change was found in static balance for both the dominant participants. The change of balance response were similar between the dominant and non-dominant side, the dominant and the non-dominant side might show cross effect of balance [31].

In modified bass test for dynamic balance, comparing right and left dominant participants same side. In right dominant participants, dancers successfully jumped 62% on right and 30% on left side. In left dominant participants, dancers scored 100% on the both side. Comparing right side of both the dominant participants P value was 0.128 which is not significant. While comparing left side of both the dominant participants P value was 0.002 which is significant [35].

According to the statistical analysis of above study we can see that the left dominant participants have better dynamic balance on both side than right dominant participants.

Right-handed people performed activities more consistently with one lower extremity when compared with left-handed dancers. The tasks used in our study presumably require more dexterity and accuracy compared to the unilateral mobilizing tasks and may be executed using different spinal pathways, possibly impeding a direct comparison [29].

Moreover, it should be noted that unilateral mobilizing tasks are hardly present during daily life or in sports and therefore show a more unstable pattern in leg preference than tasks that are more common. Single leg stance are more common in ballet dancing [29].

In hexagonal agility, comparing between right left dominant participants. Agility score of right side dominant participant were 63% on right and 23% on left side. Whereas left dominant participant scored 100% on right and 71% on left side. While comparing right side of both dominant participants P value was 0.128 which is not significant. Comparing left side of both the dominant participants. P value was 0.033 which is considered as significant.

According to the statistical analysis of above study says that left dominant participants have better agility than right dominant participants.

Agility is important in ballet dancer as they have to be quick to react, make tough transitions between dance steps, and be able to feel what they're doing [1, 5]. The hexagon test is also use measure of agility that is routinely used in the strength and conditioning profession to assess athletic performance and ability [21].

In this study they have shown that 85% of subject's right side dominant of postural stability and 20% of subject with negative correlation was found between lateral differences. Thus the postural stability of the dominant side for mobilizing functions would become greater than that of the non-dominant side [36].

This study suggests that not only mobilizing functions but also specialization of support function between left and right legs would affect the difference of postural control during single leg stance between static and dynamic balance conditions [36].

By comparing balance of right and left dominant participants. Participants of left side dominant have more balance and agility then right dominant participant [36, 34].

One of the reason for this can be left dominant sided people use both the side of the body while right side dominant people use more right side then left side of the body [36, 35].

The functional role in the supporting leg may be divided between the left and right legs according to the change in balance condition from static to dynamic [33].

11. Conclusion

From the above study we conclude that, In modified bass dynamic balance test, dancers were successfully jumped (68%) on right side and (40%) on left side. In hexagonal agility test, dancers were successfully jumped (68%) on right side and (30%) on left side. In stork balance static test, the dancers scored 12% average, 33% fair and 22% poor on right toe standing and 4% average, 66% fair and 30% poor on left toe standing. Above group have good static and dynamic balance and agility is good to fair in ballet dancers.

12. Conflicts of Interest: There was no conflict of interest.

13. Funding: No funding issue.

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