International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-5,May 2016
ISSN: 2395-3470
www.ijseas.com

Ballet Dance Portrays the Balance and Coordination Duality in Cerebellar Ataxia: A Case Report

Priscila Araújo Garcez[1], Lavinia Teixeira-Machado[2], Josimari Melo DeSantana[3]
[1]PT Health Science Degree Program, Federal University of Sergipe, Aracaju, Brazil prix_garcez@hotmail.com
[2] PhD PT Education in Health Department, Federal University of Sergipe, Lagarto, Brazil lavinia@ufs.br
[3]PhD PT Physical Therapy Department, Federal University of Sergipe, São Cristóvão, Brazil josimelo@infonet.com.br

Abstract

The causes of cerebellar ataxia are heteregeneous causing disabilities to perform some basic and essential daily activities, as working, studying, dressing, bathing, and eating. The ballet is a dance that can act connecting cerebral areas responsible to motor action, and considered as a resource of great value in functionality in this neurological disorder. The aim of the study was to assess the effects of ballet dance in cerebellar ataxia. A 28 year old young female underwent 24 lessons of ballet dance, in appropriate place, every other day, lasting one hour. The assessment measurements were: stabilometric analysis, Askevold index, fleximetry, SF-36, FIM, Romberg test, fingers to the ground test and Timed up and Go test. FIM and SF-36 scored higher in some areas, that implies improved function and quality of life. The Romberg test, TUG and fingers to the ground showed good results after treatment, these findings suggest that there was improvement in static balance, flexibility and mobility, respectively. The fleximetry showed increase in range of motion mainly in flexion and abduction of the hip and shoulder. In Askevold test showed that the patient acquired at the end of the protocol, a symmetrical self-image and near of real. Stabilometric assessment showed less sway and more centralized center of pression. The ballet dance had a fundamental role in improvement of the stimulation and body balance , mobility, flexibility, body image and, consequently, improved functionality and quality of life in this young woman.

Keywords: *brain diseases; cerebellar ataxia; dance; classic ballet.*

1. Introduction

Cerebellar ataxia is a neurological disorder carachterized by oculomotor déficit, dysarthria, dysmetria, intentional tremor, motor coordination failure, balance restriction and ataxic gait. The symptoms occur due to exacerbated inhibition of motor cortex and reduced facilitation that hampers learning and motor adjustment (Manto, Taib, 2008; Teive, 2009).

The voluntary movements in cerebelar ataxia are performed with irregular patterns, as strenght, frequency, rhythm and speed, besides slow start and inefficient accelaration and slowdown. The gait exhibits dysmetria and incoordination, which is counterbalanced by a wide base of support and excessive use of arms (Jacobi et al., 2015; Lambert et al., 2014).

In front of movement disorders, cerebelar ataxia subjects have difficulty to perform some daily living activities, like working, studying, dressing, bathing, feeding. Therefore, physical therapy must base concepts that combine chronic disease treatment and quality of life improvement (Aizawa et al., 2013; Farias & Teixeira-Machado, 2016).

As one of the goals of physical therapy intervention is to integrate the individual in his social activities offering the best quality of life dance can be an effective possibility to adapt the CA subjects to the environment he lives in, because dance works the body as a whole, besides movements integrate rhythmic, which allows sensorial, emotional, cognitive, social and motor experiences (Di Corrado et al., 2014; Teixeira-Machado & DeSantana, 2015).

Dance contributes to body balance, motor coordination and dexterity and creativity, it improves: cognitive capabilities, as memory and motivation; body image, through kinesthesic and visual perception stimulus. The act of dance activates nervous system through proprioceptive, exteroceptive and emotional information that is fundamental to development of scheme and body image (Bar & De Souza, 2016; Christen et al., 2016; Farias & Teixeira-Machado, 2016; Uzunovic et al., 2010).

The ballet dance is the most embased dance and consists of three related elements: technique, music and acting. The performance of ballet must be adjusted, pre-defined and structured by rhythm, and when it is observed in front of a mirror, it gives for individuals the ability to feel, see and activate some body regions to contribute self-squeme and to acquire a functional movement (Bar & De Souza, 2016; London et al., 2016).

The structured and stablished performances of ballet inhance harmony, symetria, body balance and physical domain. Furthermore, dancers develop flexibility, postural stability, motor coordination, lightness, elegance, grace, precision, and it allows the movement to be performed in a broad and perfect form (Teixeira-Machado, 2015; Lai & Kruse, 2016).

Likewise, it can occur in cerebelar ataxia subjects because it stimulates interaction with other people in the ballet class, and contributes to the rise of self-esteem because it is an activity that generally includes public presentations.

Thus, the aim of this study was to investigate the effects of ballet class and its influence on balance, flexibility, body awareness, functionality and mobility based on the hypothesis that this dance interferes positively on CA movement disorders.

2. Methods

A 28 year old female young, clinical diagnosis of cerebellar ataxia, right hemisphere dominant, physical therapy diagnosis of partial dysfunction to walk and activities of daily living, showed spontaneous interest in the proposed protocol based on the principles of ballet dance. Recruitment occurred in the Neurology Clinic at the University Hospital of the Federal University of Sergipe, ballet classes took place in Sergipana Academy of Ballet, and public presentation occured in Tobias Barreto Theatre.

After she assigned the inform consent and approval by Ethic Committee, the participant was submitted to assessment before the begining of classic ballet classes. The analyzed variables used were: body sway, body balance, flexibility (range of motion), functional independence, body image, quality of life. The measures were: stabilometry (Jacobi et al., 2015; Missaoui; Thoumie, 2013), Timed Up and Go (TUG-test) (Missaoui; Thoumie, 2013; Winser, 2015), fleximetry (O'Keefe et al., 2015), Functional Independence Measure (FIM) (Aizawa et al., 2013), sensitized Romberg test (Simoceli et al., 2012), Askevold index (Giardina et al. 2016; Valtolina, 1998), quality of life questionnaire (SF-36) (Graves et al., 2014). After assessment the participant began to attend 24 ballet classes. Afterward, all variables were assessed again.

2.1 Protocols

The procedures were performed in classical ballet classroom with appropriate floor (suspended wooden floor, to reduce impact on body joints) containing fixed *barres* to the wall, mirrors and sound equipment. The classic ballet classes were performed in group, lasting one hour, twice a week for three months, totaling twenty-four sessions. A choreography was performed by participant in the Tobias Barreto Theatre with another ballet dancers.

The used movements of classic ballet emphasized the development of strength, balance, dexterity, flexibility, rhythm and sense spatiotemporal dynamics associated with music and activities that promote independence, body image, and then, quality of life. Each classic ballet class consisted of the following steps: (1) at the *barre*: *plié, elevé, petit battement tendu, degagé, pointé, souplèsse, grand battement, port de bras*; (2) at the centre: *en dehors* awareness, positions of the body, *petit battements, port de bras, pas courru, pas de valse*; (3) choreography; (4) Relaxation.

The ballet dance technique acts as body integrator to allow, through its dynamic activities, neural mechanisms responsible for body position consciousness and space-temporal control for the maintenance of stability and postural orientation, demanding the production and coordination of forces that generate effective movements to control the body position in space-time (Lai&Kruse, 2016).

2.2. Positions of the Body

The ballet dancer's body remains always contracted the nipple line to the caudal direction. Its superior appendicular musculature is smooth (without extreme muscle contraction), along with the head to make the *épaulements* (associated movements of head and arms), trunk and lower limbs constantly tense and flexible legs to execute movements (Alexias; Dimitropolou, 2011; DiCorrado et al., 2014; Hamilton et al., 2006; Jarvis; Kulig, 2015; Krasnow, 2012; Kadel; Couillandre, 2007; Lai; Kruse, 2016; Pickard, 2013; Ward, 2012; Wilson et al., 2007).

The five basic positions of the human body in the classic ballet:

First position (*Première position*)	Second position (Seconde/Deuxième position)	Third position (Troisième position)	Fourth position (Quatrième position)	Fifth position (Cinquième position)
straight connected feet by the heels; arms in front of the trunk between the chest and the navel shaped of *couronne* (as if holding a big ball in front, middle fingers do not touch in front)	straight disconnected feet by the heels (the measure of a foot and a half of the dancer between heels); abduced arms in line of the shoulders, olecranons facing backwards (when ballet dancer is facing, the audience can not see the hinge of the elbow), and the palms of the hands are slightly turned to the ground	the feet are together, one in front of the other, the foot in front conceals the heel of the foot positioned posteriorly, arms - one above and the other to the body side - the upper limb above its olecranon is facing the side of the body and the palm of the hand is turned to the head of the ballet dancer, the another upper limb open to the body side, olecranon facing backward and palm of the hand turned to the ground, slightly rounded (third high position of the arms); one arm forward between the chest and the navel and the other arm to the body side, slightly rounded (third low position of the arms).	The feet are separated in abduction and external rotation, one in front of the other; arms – one in front of the trunk between the chest and the navel , and the other above its olecranon is facing the side of the body and the palm of the hand is turned to the head of the ballet dancer.	The feet are connected one in front of the another inversed side (the ankle of the one foot is in front of toes of another one); arms up above in shape of *couronne*.

The ballet dancer's body remains always contracted the nipple line to the caudal direction. Its superior appendicular musculature is smooth (without extreme muscle contraction), along with the head to make the *épaulements* (associated movements of head and arms), trunk and lower limbs constantly tense and flexible legs to execute movements (McCutchen, 2006).

2.3. Movements used in protocol

The movements below are primarily performed with the aid of the parallel barre to assist learning, as well as to provide security for ballet dancer who performs the action. The performance of these movements in the center of the classroo, without the help of the barre drives the same fundamental mechanisms for the implementation of the task, but in exponential way. They are described according to the complexity and the order should be made, so that the body gradually seize the necessary actions. The following classic ballet movements can enable the engine refinement through inter-influence of cortical intercession for the gesture improvement (Alexias; Dimitropolou, 2011; DiCorrado et al., 2014; Hamilton et al., 2006; Jarvis; Kulig, 2015; Krasnow, 2012; Kadel; Couillandre, 2007; Lai; Kruse, 2016; Pickard, 2013; Ward, 2012; Wilson et al., 2007).

a. En dehors

“En dehors” translating to "outside" is a key attribute for classical dance. The "en dehors" is nonetheless one of the movements that can be performed in the hip joint that occurs external rotation of the femur on the acetabular cup. Most steps of classical dance obey this premise due to its origin: when the court ballet was transferred to France in the seventeenth century, and went on to be staged in raised proscenium, the need arose for the dancers always keep facing the public, even when they moved from side to side of the proscenium, because the strict laws of etiquette at the time prevented them to turn their back or even stay aside for the royal audience. Then, the solution was the external rotation of the lower limbs

The static upright posture "*en dehors*" is based on: Head: Light extension of head and neck rectification, a specific diagonal line of classical ballet. Upper limbs (arms): in semi-flexion elbows and fists to the side and the hand slightly in front of its; designated preparatory position of the arms (*bras bas*). Trunk: fully erect, with adduced scapula and consequently high chest, contracted gluteus and abdomen and pelvis retroversion, promoting external rotation of the femur. Lower limbs (legs): fully extended in external rotation, one heel pointing to the other, foot abduction.

b. *Petit battement tendu degagé*

It can be done in either direction, starting on fifth or first position.

The ballet dancer must press his feet against the ground with the lower limb (leg) that will perform the action; when it runs *devant* (ahead) right leg forward, left leg supports the body's weight and the right one moves the foot starting the movement strength as of the heel and keeping the limb "*en dehors*" pushing the ground by the calcaneus, lateral side of the foot and toes. It should not be pushed with flexed toes, as this will block correct movement, the toes should be well relaxed when in contact with the ground. As the right leg will extend to the front the right heel loses contact with the ground and the pressure is transferred to the forefoot and finally the toes are stretched, as far as possible. The return to the starting position is done by keeping the same pressure on the ground, running the opposite direction.

c. *Demi plié, plié and grand plié*

They can be done in first, second, third, fourth and fifth positions, and they can be repeated several times in each position. Their importance is the strengthening of the muscles of the lower limbs and spine, and provide muscle conditioning for the implementation of movements in several ranges of motion. Body weight must be distributed on both feet igualy. The plié is present in almost all dance movements, when there is failure in plié their performance is dry, rough and bare plastic. There is a great importance of the plié, because it depends on the dance technique, stability and perfect execution of every step, since its primary function to irreplaceable muscle preparation

During its execution should stick to two opposite directions from the center of the body: one toward the head (cranial) and the other towards the ground (caudal).

As the ballet dancer flexes his legs he lengthens his spine as if the head was attached to the ceiling by a rope. This task is synchronized with the breath. According to Hiller et al. (2004), breathing associated with coordinate activities promote proper placement posture, allowing free flow of energy which promotes the self awareness and relaxation, while preparing the muscles, preventing fatigue, because it is installed more easily, since the correct breathing enhances muscle oxygenation and distributes its nutrients better.

d. *Souplèsse*

Souplèsse is a movement that the hip performs a flexion or extension in closed kinetic chain (i.e., the backbone, along with arms and head are flexioned by the hip). It can be done forward (*devant*), to the side (*de coté* or *à la seconde*), backward (*derrière*), or in circumduction (*en tournant*). It is substantial for backbone stretching and warm-up and it allows great performance, since its function is stretch muscle chains. When it done forward (*Souplèsse devant*), it extends posterior muscular chain of the spine, hip flexion is performed. When done backwards (*Souplèsse derrière*) extends above muscular chain of the trunk, trunk extension is performed, and to the side, the lateral muscles are lengthened and strengthened, since the muscles act by concentric and eccentric actions

e. *Petit battement accentué*

Its function is learning and conditioning of the support base for change of the body of a member to the two lower limbs. It can be done forward (*devant*), to the side (*de coté / à la seconde*), or backward (*derrière*). In the 5th position of the right leg forward pushing out the foot against ground, the strength starts in the heel, in the same way as *petit battement dégagé* until all toes are elongated; then rests the foot in this new position (fourth position of the feet), shifting the body weight of the left leg (support base leg) to a midpoint between the two legs. Then returns to the plantar flexion, transferring the weight to the left leg again, to return to the starting position, running the same pressures in the ground. *Petit battement accentué* assists the mechanisms responsible for the transfer of the center of body mass foward, toward or laterally. It acts in the body awareness to the directions that the body can take linearly in the horizontal plane.

f. Étendu Ramassé

Its purpose is to provide the balance for ballet dancer in one of the lower limbs to the correct execution of *pirouettes* and *fouettés*, besides providing elongated and cohesive muscles, important for the formation of muscle trophism. It starts by the first or fifth position and the foot runs to second position as a *petit battement degagé a la seconde*, when the heel rests the ground the body performs a *plié* and immediately retracts the foot to *retiré* (toes on the popliteal fossa - posterior region of the knee). Then it returns to its initial position. *Étendu ramassé* involves a number of key mechanisms for the development of motor control: a synthetic way, it triggers the vestibular system, responsible for the body balance in the various positions that the body can take, in addition it transfers the body weight of both legs for just one, while the other is suspended. This movement is the basis for the preparation of *piruettes*, and essential for the preparation of the body sensitization in various levels of complexity.

g. *Petit battement pointé*

It occurs in the same way as the petit battement dégagé, with the same force and speed of the leg as if it wanted to take off the lower limb of the body; but to stick not to shake the leg and foot: the whole leg must be fully tense, contracted, and the foot in plantar flexion forward. Then the toe touches the ground and quickly returns to its initial position in the air; the toe can touch the ground several times; also observe the maintenance of body alignment, ie the "en dehors". Its function is also in the steps of the muscle preparation that require agility and dexterity. In ataxia, the changes in the force and vectors of center of mass transfers support the perception of movement and contributes to the improvement of essential movements, such as walking.

h. *Petit battement fondu*

It can be done in either direction (*devant, de coté, derrière*). The lower limb moves the right foot to start its strength toward the heel. As the lower right limb will extend to the front, knee extension and plantar flexion, the left knee, which is supporting the body weight, flexes (fondu). The return occurs slowly extending the left leg as the right one returns to its start position. The flexion and extension movements mobilize the cerebellar ataxia body to recognize the levels and sways that the body can take in various motor tasks, such as sitting, for example. In addition it promotes strengthening of the fundamental muscles to maintain the body against gravity.

i. *Elevé* and *Relevé*

Elevé and *Relevé* rise the body from one position (*par terre*) to another position (*elevé* or *relevé*), in other words, the body moves from total support of the feet to ante-foot support. It can be done over one or two lower limbs. It is fundamental for muscle strength responsible to body balance against gravity, mainly tríceps sural (calf muscles located in posterior part of the legs).

j. Assemblé soutenu

Its function is put one lower limb movement performance over bodily axis. It can be done in either direction. Right lower limb does *petit battment fondu*, but

when it returns, left lower limb does *elevé*. The movement inclose two lower limbs jointed in fifth position (*elevé*). The basis of support is reduced in this movement, and it acts neural mechanisms responsible for body balance too.

k. *Pas Courru*

This movement is performed with lower limbs joined and basis of support on ante-feet, as in *elevé*, and the body is displaced in this position to either direction, ahead, backward, side or round. The lower limbs must be joined as something being carried on between the legs and it can not fall over.

l. *Pas Marché*

Translated from french: march stride. This movement is extremaly important, besides being a complex motor task, it promotes pelvic waist dissociation associated to alternated leg movements. The ballet dancer performs unilateral hip flexion, knee flexion and plantar flexion, and when hip full flexion without moving spine back, it extends the knee and touches the foot ahead to start the movement with another lower limb

The waist pelvic dissociation, that is, the hip rotation in the transversal plan of action involves a series of muscular contractions in various segments of the body, that allow coordinated gait movement, influencing all gait phases (stride duration, stance time, swing time, single support time, double support time stride length, step length, base of support width degree of toe out cadence, and velocity). *Pas Marché* is essential for motor improvement, as well as it assists in stretching the muscles that often are shortened in people with physical disabilities, it serves to strengthen the muscles responsible for the gait (key action for the human body move).

m. *Pas de Valse*

Step Waltz. Its performance promotes balance when the body is moving to support the weight of one leg to the other, either in the anterior-posterior or side-to-side directions. This step provides balance and coordination, because the transfer gravity action still must make in a rhythm of three-times when one foot crosses behind the other. The alternating transfer of the lower limbs (legs) can be potentialized by using the upper limbs (arms), as they can follow the movement in several different ways: either ahead, side, to the same side of the lower limb, or the other way. These actions stimulate the central nervous system to the space-time orientation in various situations. It amplifies the potential of the body in dance and in various situations of day living, while minimizing the motor patterns that inhibit the body, it expands necessary comprehension for the unexpected events as well as to predict what might happen.

3. Results and Discussion

All of measurements were apllied before and after 24 classic ballet lessons. Some movements were selected to promote motor control improvement, mainly postural control, which is the ability to assume or maintain desired position, static or dynamics (Aizawa et al., 2013; Jacobi et al., 2015; Krasnow, 2012; Lampert et al., 2014; Ward, 2012). Besides, the ballet classes stimulated functionality, body image, quality of life and self-esteem, just because the act of dance can interconnect several brain areas that influence body movement, and how it feels to act. A physically disabled person has difficulties to adapt to both internal and external constant disturbances, leading to body imbalance. The proprioception (sense of position and movement part or body parts in relation to itself) is weakened, as well as the underlying mechanisms of the vestibular system of the perception of the body in the environment (Teixeira-Machado; DeSantana, 2015; Teixeira-Machado, 2015). So, some measures were assessed to verify the influence of classic ballet in person with cerebellar ataxia.

3.1. Body balance and Mobility

Stabilometry was assessed with open and closed eyes. After 24 ballet classes, when closed eyes evaluation, participant reduced sway in both axis (anteroposterior and mediolateral), and the center of pressure (COP) reduced sway too. Stabilometry wich evaluates the static balance by analyzing the body sway, did not improve the stability of the patient with open eyes. But with the removal of visual feedback, a situation that requires more concentration and control to maintain body stability, and, consequently, of all external stimuli that could interfere with the test, there was reduction in all the situations. Timed Up and Go (TUG-test) showed reduction in time speed (3 seconds). And the sensitized Romberg test increased 24 seconds (right lower limb) and 6,6 seconds (left lower limb).

Table 1. Values of variables of center of pressure (COP), and in anteroposterior (COPy) and mediolateral (COPx) directions.

			COP	COPy	COPx
Opened Eyes	Before	Right Foot	1.09	1.88	0.64
		Body	2.57	4.2	1.02
		Left Foot	1.48	2.32	0.38
	After	Right Foot	0.75	1.57	0.56
		Body	1.44	3.43	0.92
		Left Foot	0.69	1.86	0.36
Closed Eyes	Before	Right Foot	1.06	2.2	0.6
		Body	1.71	4.87	0.95
		Left Foot	0.65	2.67	0.35
	After	Right Foot	0.51	1.81	0.34
		Body	1.16	3.44	0.72
		Left Foot	0.65	1.63	0.38

COPy= anteroposterior mean position of center of pressure in right and left foot monopodal support. COPx= mediolateral mean position of center of pressure in right and left foot monopodal support. Before and after classic ballet lessons.

Body balance and mobility increased because classic ballet evoques precise, symmetrical, synchronous and coordinated movements that were influenced beneficially, reducing base support, improving balance and concentration, greater coordination between the movements of upper and lower limbs and consequently higher walking speed (Missaoui; Thoumie, 2013; Winser, 2015).

The cerebellar ataxia is a clinical condition that presents as major consequence of the reduction of static equilibrium. Balance and concentration are benefited through classic ballet due to its movements require maintenance position for a certain time, whether with bipedal or unipodal support (Di Corrado et al., 2014; Kostic et al., 2015; Koutedakis et al., 2008; Uzunovic et al., 2010).

Ballet classes has another assistant: papallel *barres*. Being a fixed point, the *barre* can help the ballet dancer to get another attachment point of the body balance, which will assist in the execution of movements, which requires more balance control center, spatial orientation and support, as is the case of *pirouettes* and *fouettés*. The *barre* promotes an increase in the dancer's base support, and this should not put your body weight on the *barre*, but hold it lightly. It only helps the dancer in case of loss of balance and to guide direction point, especially to automate the directions that the body can follow (Alexias; Dimitropoulou, 2011; Jarvis; Kulig, 2015; Krasnow, 2012; Pickard, 2013; Ward, 2012).

3.2. Flexibility

Most assessed range of motion increased, mainly hip and shoulder flexion and extension. The composition of classic ballet class contains several movements that contributtes to flexibility in these joints. The repetition of movements in wide upper and lower limbs range of motion promotes muscular elasticity, mobility and range of motion increase (O'Keefe et al., 2015; Teixeira-Machado, 2015). These data shows the importance of classic ballet execution in flexibility.

Table 2. Joints and associated motions before and after 24 classic ballet lessons.

		Range of Motion			
		Before		After	
Joint	Motion	Right	Left	Right	Left
Shoulder	Flexion	170°	170°	170°	170°
	Extension	30°	30°	40°	40°
	Abdution	120°	120°	170°	160°
	Internal Rotation	50°	60°	50°	80°
	External Rotation	60°	80°	90°	90°
Elbow	Flexion	60°	70°	60°	70°
	Extension	90°	90°	90°	90°
Hip	Flexion - flex knee	90°	90°	120°	120°
	Flexion - extended knee	70°	50°	100°	100°
	Extension	30°	20°	35°	30°
	Abdution	40°	50°	70°	60°
	Internal Rotation	30°	30°	30°	40°
	External Rotation	30°	50 °	30°	40°
Knee	Flexion	130°	130°	140°	140°
	Extension	0°	0°	0°	0°

3.3. Body image

To analyze the body image through the body perception index, was carried Marking Procedure Body Scheme, following the Askevold protocol (Giardina et al. 2016; Valtolina, 1998). In this, the participant remains in the standing position on a sheet of paper attached to the wall at a distance determined by the length of her upper limb. The examiner will play some anatomical points of the individual (top of the head, shoulders and iliac spines) and she should mark the projection of these points on paper. Then, the examiner marks the real position of the touched points, and the difference between the real image and the percept image is calculated, besides symmetry of figure is analyzed too.

When analyze the picture format by Askevold test, it is observed that before ballet classes, the body perception was bigger and more distorted than the end of the protocol, the presented self-image was smaller and symmetrically coherent than before and closer to the real image.

The evaluation of body image test following the Askevold protocol showed that classic ballet contributed beneficially to improve the self-image. The combined movements of upper and lower limbs and head in different ranges of motions, speeds, directions and intensities provided greater control and body awareness (Giardina et al. 2016; Simoceli et al., 2012; Valtolina, 1998; Winser, 2015).

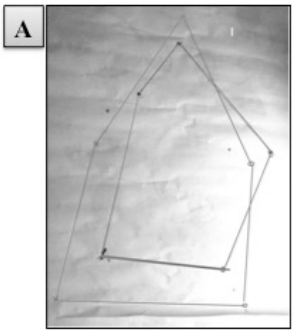

Figure 1A: Before classic ballet lessons: Real body image (bigger and symmetric) and percept body image (smaller and asymmetric).

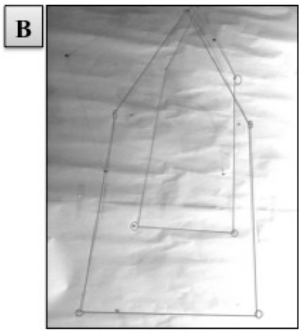

Figure 2B: After classic ballet lessons: Real body image (bigger and symmetric) and percept body image (smaller and symmetric).

3.4. Functional Independence

Through FIM assessment is observed within the items that constitute self-care, communication, mobility and self-care scores were increased, showing a modified independence in carrying out some activities. In items related to sphincter control, mobility and social cognition, the participant got the top score.

The evaluated items promoted benefits about food, hygiene and clothing. These tasks require skills such as coordination, precision and dexterity, which are enhanced in classic ballet. Social cognition and mobility require independence and dexterity to perform related movements and actions (Simoceli et al., 2012; Winser, 2015; Teixeira-Machado, 2015).

3.5. Quality of life

The results of SF-36 questionnaire analyzes quality of life perception showed that the domains of functional capability, limitations of physical aspects, pain and general state of health showed worst scores before classic ballet classes (less than 50%). Vitality, social and emotional aspects and mental health obtained values between 50 and 65% before. After classic ballet classes, and probably due to public presentation, all of the domains increased. The dance enhanced balance, flexibility, motor coordination, mobility, and quality of life, promoting daily activities. This because dance interacts motor and emotional aspects and interferes mental health through self-esteem, satisfaction, expression., socialzation, memorizing and musicality (Graves et al. 2014; Teixeira-Machado; DeSantana, 2015).

Then, some motor tasks can promote foment for inherent mechanisms of being human, although these mechanisms not being adjusted (associated reactions, synkinesis, spastic dystonia, positive reaction of support, muscle weakness, lack of skill). Classic ballet offers a range of reasoned movements described for them to be executed exquisitely (Koutedakis et al., 2008; Christen et al., 2016; Winser, 2015). Despite cerebellar ataxia difficults the primor performance of classical dance, this kind of art can contribute to neuropsychomotor development and assists bodily performances that are fundamentals to expression of possibilities that the deficient body can assume to expose feelings, desires, wills.

Functional Independence Measure (FIM)

Domains	Before	After
Self care	35	38
Sphincter control	14	14
Mobility	21	21
Locomotion	12	12
Communication	13	13
Social Adjustments	14	21
Total	109	119

SF-36 Health Survey

Domains	Before	After
Functional capacity	35%	40%
Physical aspects	0%	25%
Pain	41%	22%
General state	45%	57%
Vitality	55%	65%
Aspectos sociais	62%	25%
Emotional aspects	100%	100%
Mental health	60%	28%

Figure 2. Values of domains of Functional Independence Measure (FIM) and SF-36 Health Survey before and after classic ballet lessons.

4. CONCLUSIONS

Based on the conducted review for preparation of this manuscript, it can be seen that literature is quite sparse for a description of cases involving classic ballet movements and cerebellar ataxia. The proposed protocol proved to be effective in stimulating and improving balance, mobility, flexibility, body image and, consequently, improved functionality and quality of life in a young woman with cerebellar ataxia. However, because it is a case study, it still needs further investigation on the protocol and results.

Even so, the movement that turns into dance begins when the individual decides to enlarge its expression through body. The dance allows to know the body as a means to express themselves and show an intention by motor action. It is the mechanism by which the body translates sensitive states. From the translation of those states concerning the influence of dance, through continued practice and learning from those described movements involving the body know-how of a diverse body, outside the normal range, it can propose that dance promotes body language immersed in an abstract and concrete duality of art that portrays its sensitivity and its reality.

References

[1] C.Y. Aizawa, J.L. Pedroso, P. Braga-Neto, M.R. Callegari, O.G. Barsottini, “Patients with autosomal dominant spinocerebellar ataxia have more risk of falls, important balance impairment, and decreased ability to function”, Arq Neuropsiquiatr, Vol. 71, No. 8, 2013, pp. 508-11.

[2] G. Alexias, E. Dimitropoulou, “The body as a tool: professional classical ballet dancer`s embodiment”, Research in Dance Education, Vol. 12, No. 2, 2011, pp. 87-104.

[3] R.J. Bar, J.F. DeSouza, "Tracking Plasticity: Effects of Long-Term Rehearsal in Expert Dancers Encoding Music to Movement", PLoS One, Vol. 11, No. 1, 2016.
[4] J.F. Christen, A. Gomila, S.B. Gaigg, N. Sivarajah, B. Calvo-Merino, "Dance Expertise Modulates Behavioral and Psychophysiological Responses to Affective Body Movement", J Exp Psychol Hum Percept Form, 2016.
[5] D. Di Corrado, M. Guanera, A. Quartiroli, "Vividness and transformation of mental images in karate and ballet", Percept Motor Skills, Vol. 119, No. 3, 2014, pp. 764-773.
[6] S. Ehrenberg, "Reflections on reflections: mirror use in a university dance training environment", Theatre, Dance and Performance Training, Vol 1, No. 2, 2010, pp. 172-184.
[7] L. Farias, L. Teixeira-Machado, "Behind the dance: educational, emotional and social contexts in Down syndrome", International Journal of Humanities Social Sciences and Education, Vol. 3, No. 1, 2016, pp. 20-23.
[8] E. Giardina, T. Paul, D. Hayes, R. Sciacca, "Cardiovascular disease risk among young urban women", J Women Health, Vol. 4, 2016.
[9] T. Gibo, A. Bastian, A. Okamura, "Cerebellar ataxia impairs modulation of arm stiffness during postural maintenance", J Neurophysiol, Vol. 110, No. 7, 2013, pp.1611-20.
[10] T.D. Graves, Y.H. Cha, A.F. Hahn, R. Barohn, R. Griggs, B. Bundy, J. Jen, "Episodic ataxia type 1: clinical characterization, quality of life and genotype-phenotype correlation", Brain, Vol. 137, No. 4, 2014, pp. 1009-1018.
[11] D. Hamilton, P. Aronsen, J.H. Løken, I. BergR. , Skotheim, D. Hopper, A. Clarke, N. Briffa, "Dance training intensity at 11–14 years is associated with femoral torsion in classical ballet dancers", British Journal of Sports Medicine, Vol. 40, 2006, pp. 299- 303.
[12] D.N. Jarvis, K. Kulig, "Pointing the foot without sickling: an examination of ankle movement during jumping", Med Probl Perform Art, Vol. 30, No. 1, 2015, pp.61-65.
[13] H. Jacobi, J. Alfes, M. Minnerop, J. Konczak, T. Klockgether, D. Timmann, "Dual task effect on postural control in patients with degenerative cerebelar disorders", Cerebellum Ataxias, Vol. 2, No. 6, 2015.
[14] N. Kadel, A. Couillandre, "Kinematic, kinetic, and electromyographic (EMG) analysis comparing unsupported versus supported movements in the 'en pointe' position", Journal of Dance Medicine and Science, Vol. 11, No. 23, 2007.
[15] Y. Koutedakis, E. Owolabi, M. Apostolos, "Dance biomechanics: a tool for controlling health, fitness, and training", Journal of Dance Medicine and Science, Vol. 12, 2008, pp. 83-90.
[16] D. Krasnow, "An investigation of grand battement devant at barre, centre and in motion using kinematics and electromyography", Doctoral thesis, Dance Science Program, University of Wolverhampton, Wolverhampton, United Kingdom, 2012.
[17] R. Kostic, S. Uzunovic, T. Purenovic-Ivanovic, D. Miletic, G. Katsora, S. Pantelic, Z. Milanovic, "The effects of dance training program on the postural stability of middle aged women", Cent Eur J Public Health, Vol. 23, 2015, pp.67-73.
[18] J.C. Lai, D.W. Kruse, "Assessing Readiness for En Pointe in Young Ballet Dancers", Pediatr Ann, Vol 45, No. 1, 2016, pp. 21-25.
[19] C.S. Lambert, R.M. Philpot, M.E. Engberg, B.E. Johns, S.H. Kim, L. Wecker, "Gait analysis and the cumulative gait index (CGI): translational tools to assess impairments exhibited by rats with olivocerebellar ataxia", Behav Brain Res., Vol. 274, 2014, pp. 334-43.
[20] J. London, B. Burger, M. Thompson, P. Toiviaien, "Speed on the dance floor: Auditory and visual cues for musical tempo", Acta Psychology, Vol. 164, 2016, pp.70-80.
[21] M. Manto, N. Taib, "A novel approach for treating cerebellar ataxias", Medical Hypotheses, 2008, pp. 58-60.
[22] J.A. O'Keefe, E. Robertson-Dick, D. Hall, E. Berry-Kravis, "Gait and Functional Mobility Deficits in Fragile X-Associated Tremor/Ataxia Syndrome", Cerebellum, 2015.
[23] A. Pickard, "Ballet body belief: perceptions of an ideal ballet body from young ballet dancers", Research in Dance Education, Vol. 14, No. 1, 2013, pp. 3-19.
[24] S.A. Radell, M.L. Keneman, D. Adame, S. Cole, "My body and its reflection: a case study of eight dance students and the mirror in the ballet classroom", Research in Dance Education, Vol. 15, No. 2, 2014, pp. 161-178.
[25] L. Simoceli, D. Sguillar, H. Santos, C. Caputti, "Vestibular system paresis due to emergency endovascular catherization", Int Arch Otorhinolaryngol, Vol. 16, No. 2, 2012, pp. 282-285.
[26] H. Teive, "Spinocerebellar Ataxias" Arq. Neuropsiquiatria, 2009, pp. 1133-1142.
[27] L. Teixeira-Machado, J. DeSantana, "Dance therapy improves quality of life in individuals with neuromotor disorders: randomized controlled trial", International Journal of Humanities Social Sciences and Education, Vol. 2, No. 4, 2015, pp. 84-92.
[28] L. Teixeira-Machado, "Dance therapy in autism: a case report", Physical therapy and Research, Vol. 22, No. 2, 2015, pp. 205-211.
[29] G. Valtolina, "Body-size estimation by obese subjects", Percept Motor Skills, Vol. 86, No. 3, 1998, pp. 1363-1374.
[30] S. Uzunovic, R. Kostic, D. Zivkovic, "Effects of two different programs of modern sports dancing on motor coordination, strength, and speed", Med Probl Perform Art, Vol. 25, No. 3, 2010, pp. 102-109.

[31] R.E. Ward, "Biomechanical perspectives on classical ballet technique and implications for teaching practice", Doctoral thesis, Faculty of Science, University of New South Wales, Sydney, Australia, 2012.
[32] M. Wilson, JH. Ryu, YH. Kwon, "Contribution of the pelvis to gesture leg of range of motion in a complex ballet movement: grand rond de jambe en l` air en dehors", Journal of Dance Medicine and Science, Vol. 11, 2007, pp. 118-123.
[33] S.J. Winser, "Clinical measures of balance for people with cerebellar ataxia: Use and recommendations", PhD Thesis, Philosophy Program, University of Otago, New Zeland, 2015.

Priscila Araújo Garcez Master Degree of Health Sciences (2015), degree in Physical Therapy (2013). Member of the Research of Neuroscience Laboratory (Federal University of Sergipe, Brazil).

Lavinia Teixeira-Machado PhD (2014) and Master Degree (2010) in Health Sciences. Expert in biomechanics and Functional Kinesiotherapy. Degree in Physical Therapy, broadcaster, and professional dancer. Professor of Department of Education in Health at Federal University of Sergipe, Brazil. She is a member researcher and collaborator in the following research groups: Pain and Mobility; Art, Diversity and Contemporary. Member of Brazilian Association of Neurofunctional Physical Therapy (ABRAFIN), and the American Dance Therapy Association (ADTA). Experience in neurofunctional and dance education, acting on the following topics: body awareness, classical and contemporary dance, physical therapy and people with disabilities.

Josimari Melo DeSantana Post-doctorate in Neurobiology of Pain Laboratory, Pain Research Program, Department of Physical Therapy and Rehabilitation Science, University of Iowa, Iowa City (USA, 2007-2008). PhD (2006) and Master Degree (2004) in Health Science and Rehabilitation, Faculty of Medicine of São Paulo (FMRP-USP). Physical Therapist (University of Tiradentes, 2003). Professor at Department of Physical Therapy. Leader of Research of Neuroscience Laboratory (Federal University of Sergipe, Brazil). Member of Brazilian Society of Pain Study (SBED), American Pain Society (APS), International Association for the Study of Pain (IASP), Faculty of 1000 Medicine/ Musculoskeletal Pain Section e editora associada do Journal of Physical Therapy. She is reviewer of Archives of Physical Medicine and Rehabilitation, Brain Research Bulletin, Clinical Physiology and Functional Imaging, Contemporary Clinical Trials, European Journal of Pain (London), Fisioterapia e Pesquisa, Journal of Pain, Journal of the Peripheral Nervous System, Libyan Journal of Medicine, Pain (Amsterdam. Print), Physical Therapy, Brazilian Physical Therapy Journal, The Clinical Journal of Pain. She has approved projects with finantial support: CNPq, FAPITEC, MEC, NIH (National Institute of Health) and IASP (International Association for the Study of Pain).