

## Muscular strength, flexibility and balance analysis in women practicing ballet pilates

Análise da força muscular, flexibilidade e equilíbrio em mulheres praticantes de ballet pilates

Análisis de fuerza muscular, flexibilidad y equilibrio en mujeres practicantes de ballet pilates

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### Abstract

**Introduction:** Ballet Pilates is a way of associating Pilates principles with Classic Ballet movements. The exercises employ body weight as a load, they can be adapted according to physical condition of each one. In a short time of practice, it is possible to observe the results, such as reducing weight, increasing muscle strength and improving posture. **Objective:** Analyze the muscular strength, flexibility and balance of women who practice Ballet Pilates, comparing them as variables before and after two months of practicing the sport. **Methodology:** The present study is of intervention and field, of comparative character and quantitative nature. A survey included 14 volunteers practicing the sport, aged 20 to 50 years old, and a data collection was carry out at the Tiradentes University. Data were collect using the Lafayette isometric dynamometer, the Sanny analog fleximeter and the Arkipelago baropodometry platform. **Results:** According to a strength analysis, muscle gains were observe, especially in the quadriceps, gluteus and calves, with statistical statistics for right quadriceps ( $p = 0.008$ ) and left gluteus ( $p = 0.021$ ). In the flexibility variable, differences were observed before and after the activity execution, with positive impact on the following muscle groups: torso ( $p = 0.004$ ), hip flexors ( $p < 0.001$ ) and hamstrings ( $p < 0.001$ ). No significant difference in balance was find, measured by baropodometry, after two months of performing the Ballet Pilates modality. **Conclusion:** It was find that the Ballet Pilates modality is capable of promoting muscle strength gain, being observe in the study participants, mainly in the quadriceps and gluteus muscle groups. In addition, it became the flexibility gain exhibited by practitioners of this activity, exerting a positive influence, especially on the torso, hip flexors and hamstrings. As for balance, very expressive results were not observed, due to fact that the students have already presented balance preservation.

**Keywords:** Dancing; Evaluation; Movement.

### Resumo

**Introdução:** O Ballet Pilates é uma forma de associar os princípios do Pilates aos movimentos do Ballet Clássico. Os exercícios utilizam o peso corporal como carga, podendo ser adaptados de acordo com a condição física de cada um. Em pouco tempo de prática, é possível observar os resultados, como redução de peso, aumento da força muscular e

melhora da postura. *Objetivo:* Analisar a força muscular, flexibilidade e equilíbrio de mulheres praticantes de Ballet Pilates, comparando-as como variáveis antes e após dois meses de prática do esporte. *Metodologia:* O presente estudo é de intervenção e de campo, de caráter comparativo e de natureza quantitativa. Uma pesquisa incluiu 14 voluntários praticantes do esporte, com idades entre 20 e 50 anos, e uma coleta de dados foi realizada na Universidade Tiradentes. Os dados foram coletados utilizando o dinamômetro isométrico Lafayette, o flexímetro analógico Sanny e a plataforma de baropodometria Arkipelago. *Resultados:* De acordo com uma análise de força, foram observados ganhos musculares, principalmente em quadríceps, glúteos e panturrilhas, com estatística estatística para quadríceps direito ( $p = 0,008$ ) e glúteo esquerdo ( $p = 0,021$ ). Na variável flexibilidade, foram observadas diferenças antes e após a execução da atividade, com impacto positivo nos seguintes grupos musculares: tronco ( $p = 0,004$ ), flexores do quadril ( $p < 0,001$ ) e isquiotibiais ( $p < 0,001$ ). Não foi encontrada diferença significativa no equilíbrio, medido pela baropodometria, após dois meses de realização da modalidade Ballet Pilates. *Conclusão:* Constatou-se que a modalidade Ballet Pilates é capaz de promover ganho de força muscular, sendo observado nos participantes do estudo, principalmente nos grupos musculares quadríceps e glúteos. Além disso, tornou-se o ganho de flexibilidade exibido pelos praticantes desta atividade, exercendo uma influência positiva, principalmente no tronco, flexores do quadril e isquiotibiais. Quanto ao equilíbrio, não foram observados resultados muito expressivos, devido ao fato de os alunos já terem apresentado preservação do equilíbrio.

**Palavras-chave:** Dançando; Avaliação; Movimentação.

## Resumen

*Introducción:* Ballet Pilates es una forma de asociar los principios de Pilates con los movimientos del Ballet Clásico. Los ejercicios utilizan el peso corporal como carga, y pueden adaptarse según la condición física de cada uno. En poco tiempo de práctica, es posible observar los resultados, como reducción de peso, aumento de la fuerza muscular y mejora de la postura. *Objetivo:* Analizar la fuerza muscular, la flexibilidad y el equilibrio de mujeres practicantes de Ballet Pilates, comparándolos como variables antes y después de dos meses de práctica del deporte. *Metodología:* El presente estudio es de intervención y de campo, de carácter comparativo y cuantitativo. Se encuestó a 14 voluntarios que practicaban el deporte, con edades entre 20 y 50 años, y se realizó una recolección de datos en la Universidad de Tiradentes. Los datos fueron recolectados utilizando el dinamómetro isométrico Lafayette, el flexímetro analógico Sanny y la plataforma de baropodometría Arkipelago. *Resultados:* Según análisis de fuerza, se observaron ganancias musculares, principalmente en cuádriceps, glúteos y pantorrillas, con estadística estadística para cuádriceps derecho ( $p = 0,008$ ) y glúteo izquierdo ( $p = 0,021$ ). En la variable flexibilidad se observaron diferencias antes y después de la actividad, con impacto positivo en los siguientes grupos musculares: tronco ( $p=0,004$ ), flexores de la cadera ( $p < 0,001$ ) e isquiotibiales ( $p < 0,001$ ). No se encontró diferencia significativa en el equilibrio, medido por baropodometría, luego de dos meses de realizar la modalidad de Ballet Pilates. *Conclusión:* Se constató que la modalidad Ballet Pilates es capaz de promover la ganancia de fuerza muscular, observándose en los participantes del estudio, especialmente en los grupos musculares cuádriceps y glúteos. Además, se convirtió en la ganancia de flexibilidad exhibida por los practicantes de esta actividad, ejerciendo una influencia positiva, principalmente en el tronco, flexores de cadera e isquiotibiales. En cuanto al equilibrio, no se observaron resultados muy expresivos, debido a que los estudiantes ya habían presentado preservación del equilibrio.

**Palabras clave:** Bailando; Movimiento; Evaluación.

## 1. Introduction

Ballet Pilates was developed in England, being an activity that mixes the principles of Pilates, which emphasizes the control of mind over body, gentleness, precision and harmony, with the principles of Ballet Barre Workout, that aims at an upright posture, in external rotation of the lower limbs, circular movements of the upper limbs, body verticality, discipline, lightness, harmony and symmetry (Bernardi, 2017).

The exercises use the student's own body weight as a load, being adapted accordingly to the physical condition of each one of them. In a short time of practice of the activity, it is possible to see the results, such as weight loss, increased muscle strength and posture improvement (Gosling, 2017). The Ballet Pilates method is based on studies of posture control and core stability. It uses music, dance and numerous accessories as a motivational tactic. Grounded by the principles of Pilates and the movements adapted from Classical Ballet. Therefore, it provides an improvement in body structure and posture (Piccini, 2014).

Classical ballet is a result of the transformation of the primitive dances, becoming a dance formed by steps, connections, and previously prepared gestures originated of the primitive dances, becoming a dance formed by steps, connections, and previously prepared gestures originated from the court dances and other influences. Classes and practice are

part of the training routine of the dancers, who seek to constantly acquire the technical and body specific skills required to dance. The search to obtain a performance quality directs the dancer to the Pilates method, which is capable of generating two important and indispensable skills for its technical performance, flexibility and muscular strength (Amaral, 2009).

The word flexibility is an ability that refers to the extensibility of the periarticular soft tissues, allowing the physiological movement, being the result of stretching (Alter, 1999). It is related to factors such as mobility, elasticity, plasticity and malleability, consequent of basic body components: bones, muscles, tendons, ligaments and joint capsules (Souza et al., 2006).

To increase the range of motion (ROM) of a joint, stretching, in addition to promoting tissue extensibility, should reduce muscular tension, increase coordination of body segments and the strength of the agonist muscle group. The improvement in flexibility has a linear relationship with the increase of muscular strength due to the force-length relationship, meaning, with the increase of this skill, the exercises can be performed with greater amplitude, strength, ease and speed, in a more fluent and effective way (Bertolla et. al., 2007).

Several factors interfere with flexibility, some internal such as genetics, gender, age, muscle and fat volume, as well as external factors including training, temperature and environment. Among these, there is an emphasis on gender, as women are generally more flexible than men. Studies report that the greater amount of estrogen hormone in females causes less development of muscular mass and concentrates more water and polysaccharides than in males, reducing the friction between muscle fibers, being responsible for greater flexibility (Achour, 2004).

While flexibility is a term used to describe a component of aptitude related to physical well-being, stretching is the technique used to improve flexibility through muscular elasticity, by placing the stretched muscle beyond its usual size. This variable is considered an important component of physical fitness, related to health and athletic performance (Badaro et. al., 2007). It is known that most activities of daily living require a relatively normal degree of flexibility. However, certain activities such as ballet require greater flexibility to achieve a superior performance (Prentice, 2003).

Postural control is an integral part of the human motor control system, which is perceived as the maintenance of a specific posture of the body with minimal oscillation, when assessing static balance, or the maintenance of posture during a motor practice, when assessing dynamic balance. The exerted forces counterbalance and cancel each other out, due to the somatosensory system providing information regarding the position of the body with the environment concerning the support/base surface, body velocity and information that will act on the pressures on the interface of the structure segment base, making the body capable of moving more readily, in a multidirectional way, with coordination and safety, in face of extrinsic stimuli (Teixeira et al., 2010).

The beginning of postural control aiming at the vertical position occurs around the first year of life, when the child independently discovers orthostasis. The first attempts are made with simple and yet disorganized movements, which will be perfected in the course of life (Barela, 2000; Feitosa et al., 2008). In each phase, different mechanisms are used to obtain information contained in the environment to assist in postural and locomotor control (Calve; Castro, 2005).

## **2. Methodology**

The present study is a pilot, interventional, of comparative character and quantitative nature, carried out with authorization and signing of an Informed Consent Form by the evaluated students. This modality was chosen to provide an understanding of the effects of muscular strength, flexibility and balance in Ballet Pilates women practitioners.

The project was sent to the Research Ethics Committee (REC) and approved under number of protocol 3824947. The terms of Resolution 466/12, December 12th, 2012, of the National Health Council of the Ministry of Health were respected, as well as the rules and resolutions arising from the Common Market Group (CMG) No. 129/96, complying with Law 6,360

(September 23, 1976), in particular Art. 76, regulated by Decree No. 79,094 (January 5, 1977).

The research was carried out at Tiradentes University, in the city of Aracaju – Sergipe. Women practitioners of Ballet Pilates who met the inclusion criteria described below were individually evaluated and subsequently reassessed two months after the first evaluation. The sample attended to convenience, reaching a demand of 14 participants, making up the pilot study, with recruitment made in the studio where the practice of Ballet Pilates occurs.

Women who practiced any other physical activity simultaneously or who had any pathology that interfered with balance, muscular strength or flexibility were excluded from the study. Women aged from 20 to 50 years old who practice the activity an hour three times a week were included.

The data was collected by the researchers themselves, using the Lafayette isometric dynamometer, the Sanny analog fleximeter and the Arquipelago baropodometry platform. The volunteer was asked to remain seated to evaluate the quadriceps muscular strength, starting with the left lower limb, followed by the right, instructing the volunteer to perform maximum strength.

Afterwards, the volunteer was placed in the ventral decubitus, with knee flexion and hip extension to evaluate the muscular strength in the glutes, following the same protocol. The muscular strength of the triceps surae was evaluated in the dorsal decubitus, maintaining a plantar flexion pattern, therefore completing the evaluation of the strength of the propulsion complex.

As for the range of motion, the volunteer, in orthostasis, was asked to perform an anterior torso flexion to evaluate torso flexibility. Then, the volunteer was placed in dorsal decubitus and performed the elevation of the lower limbs, first the left limb and then the right limb, to evaluate the flexibility of the hip. In this same decubitus position, the volunteer was evaluated in ankle flexibility for dorsiflexion and plantar flexion movements, following the same protocol. In the lateral decubitus position, she was submitted to an evaluation of flexibility of hip extension, completing the evaluation of this variable.

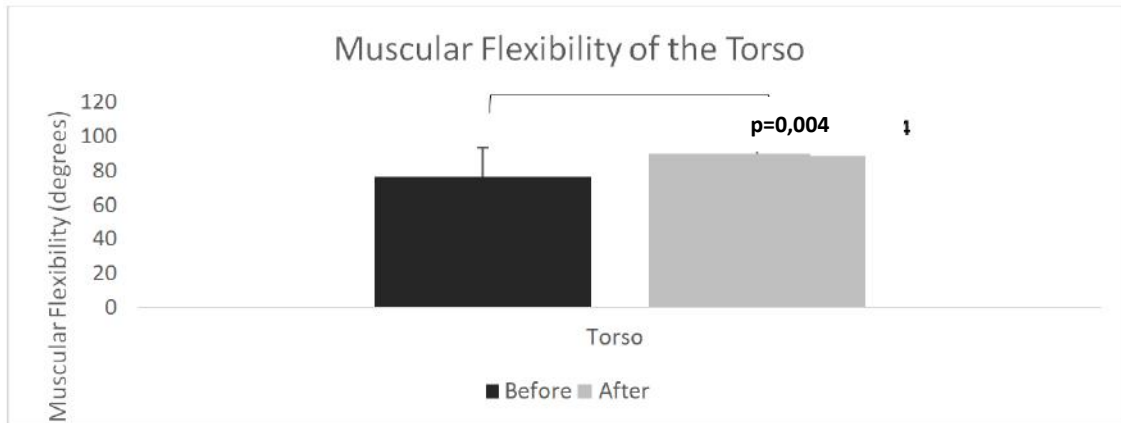
The balance evaluation was performed statically, with bipedal support and with the participants' eyes closed. It is noteworthy that the collection, both initial and final, of these variables was always carried out by the same researcher, as well as the obligatory use of a stabilizer belt in all muscular strength measurements that were performed.

The data was analyzed descriptively and analytically. Categorical variables were presented by absolute (n) and relative (%) frequencies. Numerical variables were observed for normal distribution with the Shapiro-Wilk test and presented by average ( $\bar{x}$ ) and standard deviation (SD). For comparison, it was applied Student's t-test and presented by the difference of the average and the respective confidence intervals. Statistical significance was adopted at 5% ( $p \leq 0,05$ ). The statistical program used was the Statistical Package for the Social Sciences (SPSS 15.0).

### **3. Results**

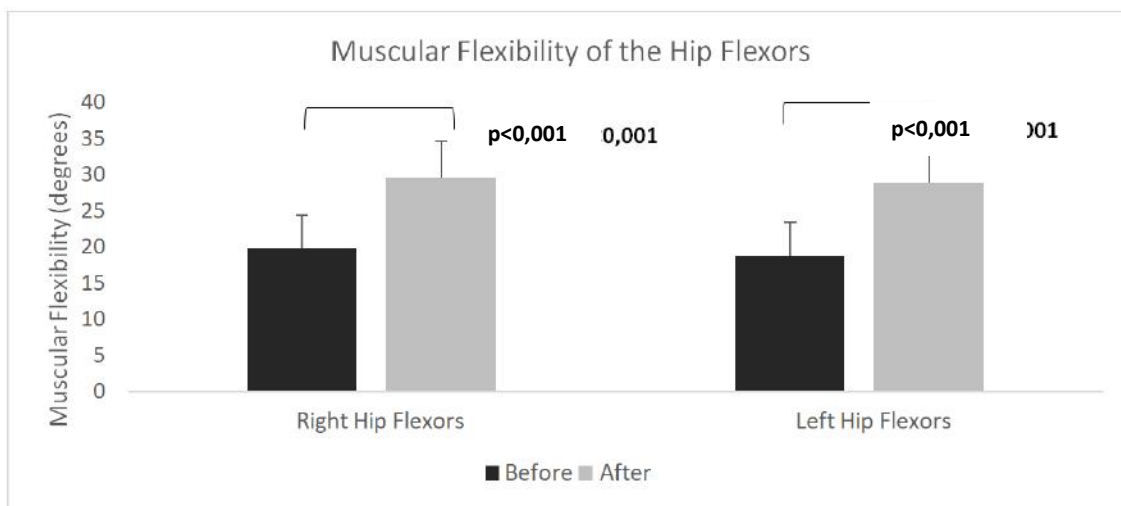
After data collection, the flexibility evaluation was carried out, being verified significant differences before and after the performance of the activity, with a positive impact on the muscle groups: torso ( $p=0,004$ ), hip flexors ( $p<0,001$ ) and hamstrings ( $p<0,001$ ), respectively (Figures 1, 2 and 3).

**Figure 1** - Analysis of muscular flexibility of the torso before and after three months of practicing Ballet Pilates. Statistical significance ( $p \leq 0,05$ ).



Source: Authors.

**Figure 2** - Analysis of muscular flexibility of the hip flexors before and after three months of practicing Ballet Pilates. Statistical significance ( $p \leq 0,05$ ).



Source: Authors.

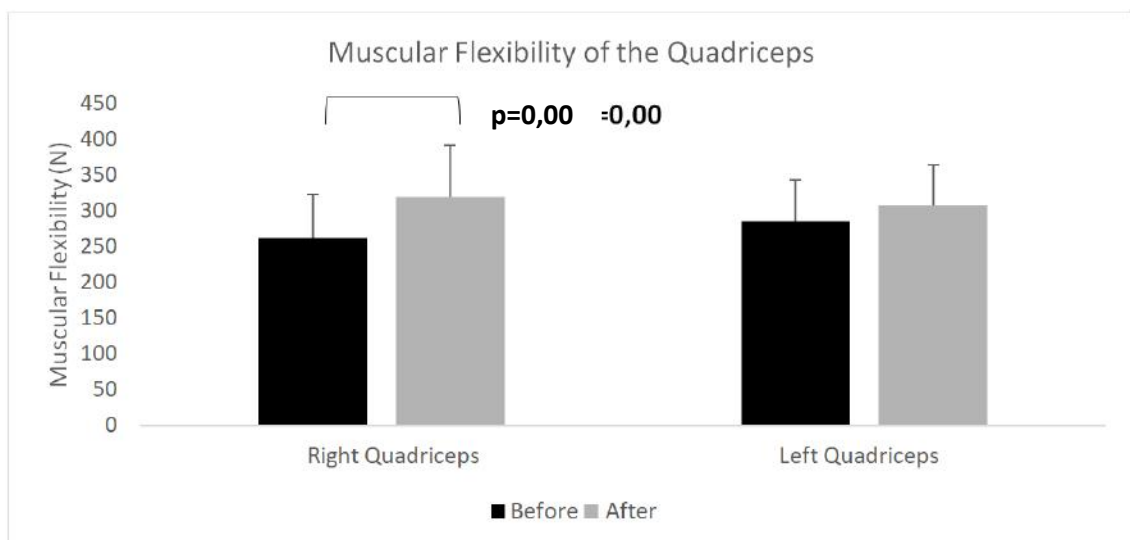
**Figure 3** - Analysis of muscular flexibility of the hamstrings before and after three months of practicing Ballet Pilates. Statistical significance ( $p \leq 0,05$ ).



Source: Authors.

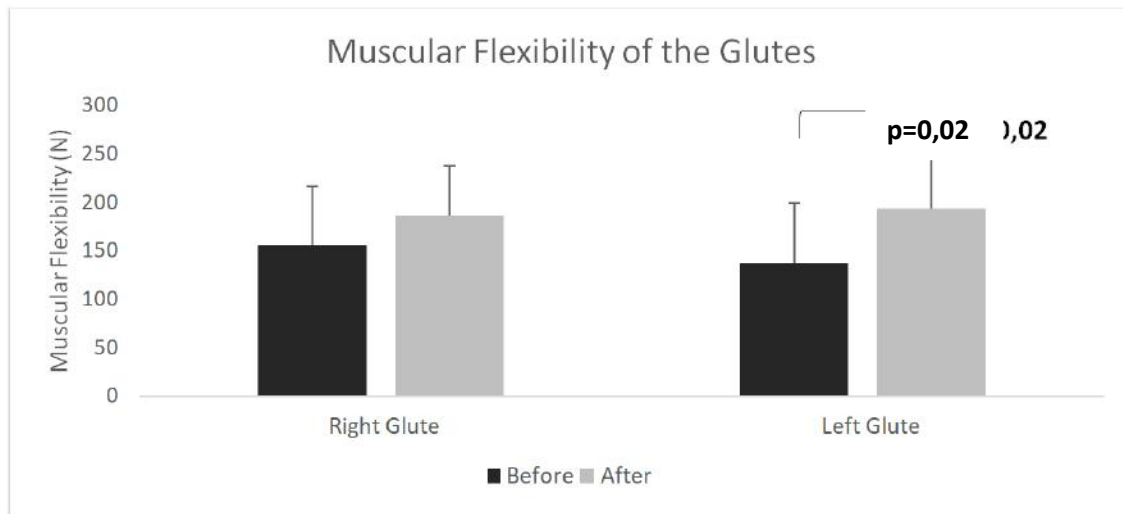
According to the strength analysis, it was showed muscle gain, especially in quadriceps (Figure 4), glutes (Figure 5) and triceps surae (Figure 6), with statistical differences for quadriceps D ( $p = 0,008$ ) and gluteus E ( $p=0,021$ ).

**Figure 4** - Analysis of muscular flexibility of the quadriceps before and after three months of practicing Ballet Pilates. Statistical significance ( $p \leq 0,05$ ).



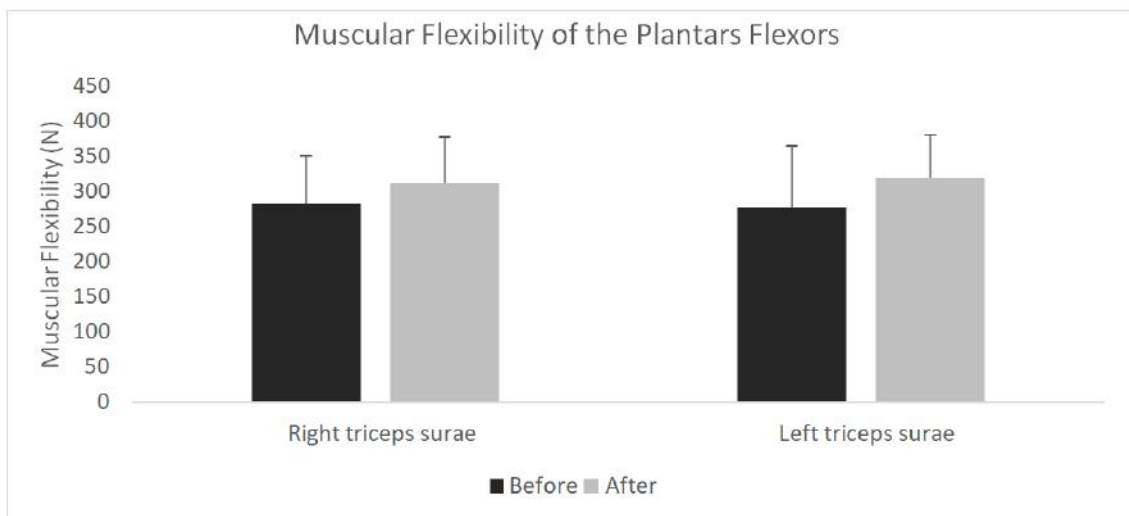
Source: Authors.

**Figure 5** - Analysis of muscular flexibility of the glutes before and after three months of practicing Ballet Pilates. Statistical significance ( $p \leq 0,05$ ).



Source: Authors.

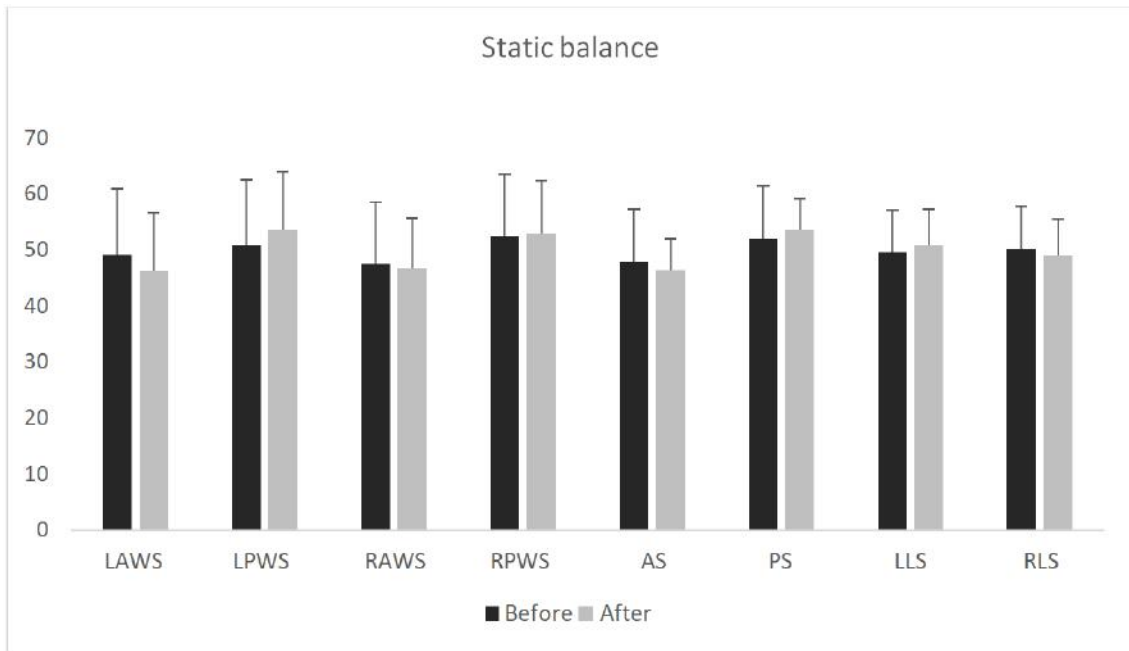
**Figure 6** - Analysis of muscular flexibility of the plantar flexors before and after three months of practicing Ballet Pilates. Statistical significance ( $p \leq 0,05$ ).



Source: Authors.

No statistical differences were found before and after three months of practicing Ballet Pilates in regard of the balance analyzed by baropodometry. This result can be justified by the fact that the students already presented preservation of this variable prior to the activity, according to the normality values presented in the study (Figure 7).

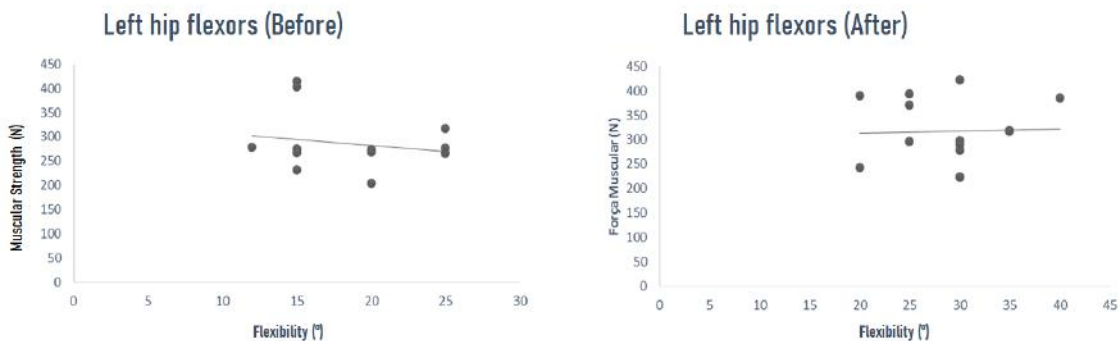
**Figure 7** - Analysis of static balance before and after three months of practicing Ballet Pilates. LAWS: left anterior weight shift; LPWS: left posterior weight shift; RAWS: right anterior weight shift; RPWS: right posterior weight shift; AS: anterior shift; PS: posterior shift; LLS: left lateral shift; RLS: right lateral shift; \*Statistical significance ( $p \leq 0,05$ ).



Source: Authors.

When correlating the Muscular Strength and Flexibility variables, after three months of practicing Ballet Pilates, it was noticed a proportional gain in both strength and flexibility in the group of right hip flexors (Figures 8 and 9). In the correlation of the variables of the left hip flexors (Figures 10 and 11), it was possible to analyze that strength remained stable, while there was an increase in flexibility. Although such analyzes showed weak correlations, there was statistical significance in all of them, with  $p < 0,0001$ .

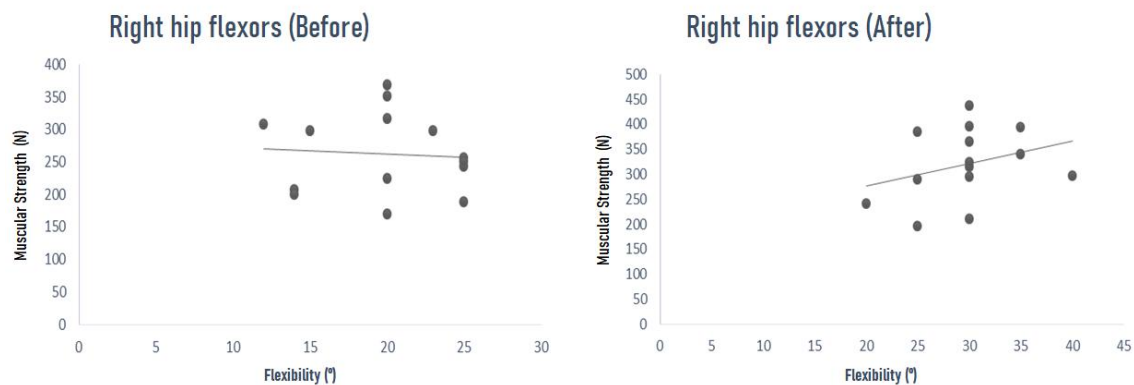
**Figures 8 and 9** - Correlation between muscular strength and flexibility in the right hip flexors before ( $R = -0.067$ ;  $p < 0.0001$ ) and after ( $R = 0.316$ ;  $p < 0.0001$ ) of three months of practicing Ballet Pilates.



Source: Authors.



**Figures 10 and 11** - Correlation between muscular strength and flexibility in left hip flexors before ( $R=-0.208$ ;  $p<0.0001$ ) and after ( $R=0.037$ ;  $p<0.0001$ ) of three months of practicing Ballet Pilates.



Source: Authors.

#### 4. Discussion

In the study, the variables muscular strength, flexibility and balance were evaluated, as well as their impact on the lives of women practitioners of Ballet Pilates, in order to obtain a better understanding of the benefits attributed to this activity, as it is an innovative practice, newly developed and with a shortage of national and international scientific publications.

Oliveira et al. (2015), when conducting a study with young Pilates women practitioners, concluded that this activity not only promotes muscle strengthening of the body axis, but also of the upper and lower limbs. For the lower limbs, especially, the level of muscle strengthening can be very important during the performance of daily tasks, and it can contribute favorably to the improvement of sports performance. Similarly to these results, in the present research, positive results of muscular strength were evidenced after a period of two months of Ballet Pilates practice.

According to Santos (2016), Classical Ballet seeks high performance standards, which contain movements that generate great muscular strength and joint range of motion. However, it turns out it demands a high degree of muscle tension to develop the necessary physical skills and fit the aesthetic standards. Likewise, the ballet principles applied in Ballet Pilates are nomenclatures, positions and movements that are exercised in an adapted manner to the principles of Pilates. For Souza (2017), it is a hybrid between these two variables. Lara (2017) adds that it's the pursuit for a combination between the two genres, characterizing the beauty of Ballet with the lightness of Pilates. Additionally, Ballet Pilates uses exercises with high muscle tension, as it works primarily to stabilize muscles, in addition to which, even using only the principle of body weight, it is able to contribute to the gain of muscular strength, as observed in the final result of the study.

Souza (2017) carried out a research focused on the practice of the Ballet Pilates method on physical preparation in classical dance ballerinas. Thus, he stated that this activity not only works by defining the musculature, but also by strengthening the entire cardiac, respiratory and lymphatic system, as well as improving stretching, body posture and flexibility, preventing injuries. Thus, Lara (2017) adds that Ballet Pilates proposes to offer safety for body movements, without causing injuries to practitioners, respecting its particularity and encouraging the ideal body posture during the execution of exercises

In the current study, it was noticeable that the findings corroborate the ideology of the aforementioned authors, since the participants obtained significant improvement in muscular strength in the quadriceps and gluteus and in the flexibility of the muscles of the torso, hip flexors and knee flexors during the two months period of practice of the activity. Parallel to this, the research carried out by Lima et al. (2011) found a more considerable benefit both in flexibility and in the muscular strength

of the abdominal muscles, through the practice of Pilates, when compared to single weight training.

According to the study by Oliveira et al. (2015), the fleximeter is the best resource to compare static stretching obtained through the practice of the Pilates method on muscle flexibility. In their study, the hip flexor, hamstring, plantar and dorsiflexor muscles were selected for analysis after three months of practicing Pilates, with this activity being performed twice a week during 60 minutes. Thus, there was a significant increase in flexibility in all movements. These results confirm the data found in this research, since the same protocol of the aforementioned author was used and flexibility optimization was found in the same muscle groups after the practice of Ballet Pilates.

Bankoff et al. (2006) evaluated static balance with an electronic baropodometer in a single-pedal and bipedal way, with eyes open and closed, respectively, to compare the oscillations of the center of body mass between men and women and concluded that several factors and variables influence directly and indirectly human balance, such as mechanical, anthropometric and neuromuscular factors. Schmidt et al. (2003) complemented that the use of baropodometry, even being a contemporary technology, is effective for the study of human balance. Regarding the balance variable, in the present study, a baropodometry platform was used to evaluate the anterior, lateral right, left and posterior shift. However, no statistical differences were found regarding this variable and that can be explained by the fact that the students already showed balance preservation even before starting the activity.

## 5. Conclusion

Based on the present study, it was found that Ballet Pilates is able to promote muscular strength gain, being observed in the study students, mainly in the quadriceps and gluteal muscle groups. Besides that, the flexibility gain presented by the practitioners of this activity became notorious, exerting a positive influence, especially on the torso, hip flexors and hamstrings. As for balance, no expressive results were noticed, due to the fact that the students already had preserved balance previously, not showing changes in this study variable.

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