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**Original Article**

# Strength and flexibility in beginner jazz dancers

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**Abstract**
Strength and flexibility are two physical qualities that complement each other and which are fundamental to the technique of jazz dance. Thus, the aim of this research was to determine how the work of jazz dance influences the strength and flexibility of beginner dancers, seeking performance differences over a period of three months of practice. The study was conducted in Porto Alegre, Brazil, with eight dancers practicing jazz dance twice a week, with an average age of 20 years. For the assessment of physical fitness, tests were applied before the start of classes in jazz and after 24 lessons. For strength, the vertical jump test, the handgrip test (dynamometry), and the abdominal resistance test were applied. To evaluate the flexibility of the dancers the goniometer was used, which is designed to measure joint angles of the human body. The assessed joints were: flexion, hyperextension and abduction of the hip, and hyperextension of the spine. After a total of 24 days/lessons of practice, the tests were performed again and the results analyzed. The results showed a significant difference in all tests except dynamometry. It is therefore considered that 24 sessions of jazz dance influenced the flexibility of all the variables, the strength of the vertical jump and the abdominal resistance in beginner dancers. There were significant statistical differences in all these variables, with gains shown in range of motion and muscle strength.
**Keywords:** Strength. Flexibility. Jazz dance. Physical fitness.

## Introduction

Flexibility is the ability to perform movements in body joints with appropriate range of motion (Barbanti, 2003). It is the quality of the joint to be flexible and easily mobilized without the tendency to disrupt (Dorland et. al, 1999). Flexibility determines the full mobility of individuals, as well as promoting agility, preventing accidents and improving the mechanical ability of muscles and joints, which allows more economical use of energy during exertion (Cyrino et. al, 2002).

Strength is the tension level that can be produced by muscles or specific muscle groups through voluntary contractions of muscle fibers (Guedes; Guedes, 2006). Strength training develops important fitness qualities and constitutes an excellent form of physical preparation due to its ease of adaptation to the individual's physical condition. The training itself improves body composition, muscle strength, functional capacity, and flexibility, among other things (Cyrino et. al, 2002).

Dance requires the development of various components, because many of the moves, such as a great leap into the air, need as much flexibility to execute as they do strength (Grego et. al, 2006). A common mistake in dance training is the emphasis on flexibility, neglecting strength and other physical qualities. When training is performed in such a disorganized manner, there's no gain in technique, leading to the dismay of the dancer (Robertson, 1988). In jazz dance, the bodies must be agile, strong and flexible, so it's necessary to create an effective body workout which includes strength and flexibility exercises to achieve the desired movement (Correia, 2007).

Although the specific needs of a jazz dancer's conditioning are not accomplished through flexibility and strength training alone, these physical qualities are very important for a quality result in performance and so are the focus of this study. In this sense, strength and flexibility are presented as physical qualities that complement each other. Thus, the aim of this research was to determine how the work of jazz dance influences muscular strength and flexibility in beginner dancers, seeking differences in these variables over a period of three months of practice, totaling 24 sessions.

## Material and Methods

### Participants

This research is characterized of semi-experimental and quantitative analysis (Gaya et. al, 2008). It was conducted in the "Carol Dalmolin Dance Studio", located in Porto Alegre, Brazil, with authorization of completion granted by site owner. The sample, type non-probabilistic intentional (Gaya et. al, 2008), was


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comprised of eight beginner female jazz dancers, all female, between 15 and 23 years of age, with an average age of 20. The inclusion criteria used were as follows: female, joining the jazz beginner lessons at the "Carol Dalmolin Dance Studio" twice a week, and not participating or starting another kind of physical activity that could influence the study. The performance of the physical fitness test before they started jazz lessons and after 24 sessions did not count towards their measure of physical activity. Exclusion criteria were as follows: having more than two absences during the testing period, and practicing another kind of physical activity or other type of dance. The study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul (UFRGS), under protocol number 965.725. All participants signed an informed consent form before the testing period, agreeing to participate in the study.

**Experimental Design**

After signing for informed consent, the participants took part in the initial strength and flexibility tests. During the next three months, they were exposed to hour-long jazz dance classes twice a week. After 24 sessions, an evaluation of the participants was conducted that resulted in post values of strength and flexibility in the individual participants.

**Evaluation Protocols**

For data collection, physical fitness tests were conducted to measure the strength and flexibility of the dancers. The muscular strength tests were: the vertical jump test (VJ) (Johnson; Nelson, 1979), which aims to measure the explosive strength of the lower limbs, the abdominal resistance test of one minute (AR) (AAHPERD, 1976), which aimed to measure the efficiency of abdominal muscles and hip flexors, and the handgrip test (HG) through dynamometry, to measure isometric strength through handgrip actions. For this last test, a manual dynamometer was used, mark Simons Preston.

To evaluate the flexibility of the participants a Goniometer 20A was used, mark Flexiometer 180º TKK. This device was used to measure the joint angles of the dancers. To perform the goniometry, passive movement is recommended, i.e. the individual performs the movement and, in final degrees, can receive assistance from the evaluator (Marques, 2003). The joints evaluated in this study were: hip flexion with right leg (FRH) and left (FLH), hip hyperextension with right leg (HRH) and left (HLH), hip abduction with right leg (ARH) and left (ALH), and hyperextension of the spine in lumbar (HSL) and thoracic (HST) regions.

***Proposal of intervention***

The sample subjects were submitted to a three-month observation where they attended 24 jazz dance classes, lasting 60 minutes each and occurring twice a week. Lessons taught were divided into blocks, described in Table I.

**Table I** – Structures of Jazz Dance Classes

| Blocks | Time | Content |
|---|---|---|
| Block 1 | 15 min | Joint heating and stretching, with emphasis on the muscles of the lower limbs and the muscles that are most used during the class. |
| Block 2 | 40 min | Work of jazz dance technique, training movements like legs releases (*grand battements*), pirouettes and leaps, such as *grand jeté, entrelacé, sissone, atittude,* etc. |
| Block 3 | 15 min | Choreographic sequence, using the elements learned in class, with progressions of difficulty every day. |

***Statistical Analysis***

Descriptive statistics were used and the values were expressed as means, medians and standard deviations. Shapiro-Wilk test, paired t-test and Wilcoxon test were used to compare the tests (pre and post). To evaluate the reproducibility of the test, the intra-class correlation coefficient (ICC) was used, with a confidence interval (CI) of 95%. ICC was classified as low (<0.4), good (0.4 ≤ ICC <0.75), and excellent (≥0.75) (Fleiss; Levin; Paik, 2004). Significance level adopted was 0.05 and statistics were performed using IBM SPSS 18 software.

**Results**

Tables II and III present the results of average, median, standard deviation and ICC strength and flexibility testing, comparing the students tests before and after 24 jazz dance sessions, in all the studied variables.

Table II presents data relating to tests of strength: the handgrip test, the use of the dynamometer device (HGR and HGL), the vertical jump test (VJ), and the abdominal resistance test (AR). Table III shows the results obtained in flexibility tests using the goniometer appliance joints: hip flexion (FRH and FLH), hip hyperextension (HRH and HLH), hip abduction (ARH and ALH), and hyperextension of the spine (HSL and HST).

**Table II** – Results: strength tests (n=8)

| | Before | | | After | | | | Correlation Test | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Average** | **Median** | **SD** | **Average** | **Median** | **SD** | **p** | **ICC** | **IC 95%** | **p** |
| HGR (kg) | 25,25 | 24,00 | 2,55 | 26,50 | 25,50 | 3,55 | 0,34 | 0,74 | -0,31;0,95 | 0,05* |
| HGL (kg) | 22,88 | 22,50 | 4,12 | 24,00 | 22,50 | 4,34 | 0,22 | 0,92 | 0,58;0,98 | 0,002* |
| VJ (cm) | 33,25 | 34,00 | 5,26 | 37,31 | 36,25 | 7,32 | 0,01* | 0,95 | 0,76;0,99 | < 0,001* |
| AR (nº de repet. | 28,50 | 24,50 | 10,09 | 33,50 | 29,00 | 8,49 | 0,01* | 0,97 | 0,87;0,99 | < 0,001* |

* Significant difference (significance level of p<0,05). SD = standard deviation

**Table III** – Results: flexibility tests (degrees) (n=8)

| | Before | | | After | | | | Teste de Correlação | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Average** | **Median** | **SD** | **Average** | **Median** | **SD** | **p** | **ICC** | **IC 95%** | **p** |
| FRH | 113,38 | 115 | 10,98 | 120,63 | 119 | 9,49 | 0,01* | 0,84 | 0,20;0,97 | 0,01* |
| FLH | 112,5 | 115 | 10,21 | 119,75 | 123 | 8,66 | 0,01* | 0,94 | 0,68;0,99 | 0,001* |
| HRH | 46,88 | 47 | 4,55 | 56,13 | 55,5 | 5,79 | < 0,001* | 0,82 | 0,12;0,96 | 0,02* |
| HLH | 45,25 | 44,5 | 5,23 | 57,25 | 56 | 7,25 | < 0,001* | 0,81 | 0,04;0,96 | 0,02* |
| ARH | 70 | 70 | 6,46 | 79,38 | 78 | 7,29 | 0,001* | 0,86 | 0,32;0,97 | 0,01* |
| ALH | 70 | 70 | 6,46 | 79,38 | 78 | 7,29 | 0,001* | 0,86 | 0,32;0,97 | 0,01* |
| HSL | 55,75 | 55,5 | 6,2 | 66,25 | 66,5 | 4,46 | 0,01* | 0,65 | -0,77;0,93 | 0,01* |
| HST | 80 | 81 | 5,45 | 88,63 | 90 | 2,26 | 0,01* | -0,05 | -4,22;0,79 | 0,52 |

* Significant difference (significance level of p<0,05). SD = standard deviation

Considering a significance level p<0.05, one notices significant differences for the VJ test (p=0.01), the AR test (p=0.01), and for all tests of flexibility with both legs. However, for the HGR and HGL tests there was no significant difference between pre and post-test results.

The results of ICC were excellent and good, according to classification of Fleiss, Levin and Paik (2004), in most part of the variables of flexibility and all the tests of strength. Statistically significant differences were found in most variables, except in HST, indicating that the intervention used was appropriate for the studied sample and points to a high correlation between pre and post-testing. (Tables II and III).

**Discussion**

In conclusion, the work of jazz dance did influence the improvement of strength and flexibility of the sample over the three-month period of practice. Statistically significant differences were found in all flexibility tests (FRH, FLH, HRH, HLH, ARH, ALH, HSL, HST), in the VJ test and the AR test. According to the outcome of ICC, one realizes that the protocol used in jazz dance classes proved to be effective, since the vast majority of the tests showed high correlation.

In Table II it can be observed that there were no significant gains for handgrip strength in the HGR and HGL tests. This result is consistent with the findings of Prati and Prati (2006) when they evaluated classical dancers through the dynamometer test and obtained a strength level lower than suggested and expected by researchers. Relating the data obtained from the study made by Matsudo and employees (2003), the sample had a regular handgrip strength in pre-test (average of 25.25 kg with right hand and 22.88 kg with left hand) and remained level in post-test results (average of 26.50 kg with right hand and 24 kg with left hand). It is believed that these results were found because there was not a specific technique in the jazz dance classes to strengthen the hands.

The values found in relation to the explosive force of lower limbs were higher than the study performed by Prati and Prati (2006), who obtained an average of 36.8cm for the VJ test. The results also differ from the study developed by Fração and co-authors (1999), in which classical dancers had gone through training for 14 weeks and the results showed no significant difference in VJ test. However, the jazz dance study reinforces the results found by Grego and employees (2006), in which dancers from classical ballet, jazz dance and street dance achieved a better performance in the VJ test than girls of the same age who practiced physical education classes.

Jumps are common in jazz dance technique and are frequently taught during lessons and also in choreography. The development and strengthening of the lower limb muscles is imperative, since a lot of work is required of these muscle segments by actively participating in the thrusting movement of jumping. Thus, it should be noted that the tests performed in this study were well structured to test the development of explosive strength of lower limbs, and results found a high correlation between pre and post-test strengthening (Table II).

The values of abdominal resistance force were higher than those of the study performed by Prati and Prati (2006), who obtained an average of 23 repetitions for abdominal resistance test in one minute. Due to the need for abdominal strength required in jazz, both for correct posture and for appropriate balance between anterior and posterior spine musculature, specific exercises were carried out in each jazz dance lesson to increase strength gains in this muscle.

Strength, displayed in explosive and abdominal resistance, is widely used in jazz dance technique, and therefore should be well developed in class, so as not to jeopardize the execution of movements. If the training is not enough, and the muscles are underdeveloped, the effectiveness and the subtlety of movement may be limited (Prati; Prati, 2006). In addition, according to Watkins and Clarkson (1990), a dancer must practice the three important principles of strength training: overload, which is increasing the intensity of exercises for each lesson, specificity, which is choosing exercises that are similar to the movements of dance classes and choreography, and reversibility, which is the ability to perform the training at least twice a week, to maintain desired levels of strength. And it was in this way, using these three basic principles, that jazz dance classes were conducted in this study.

In the test it was observed that in hip flexion with both legs, the dancers studied are within the normal range, with 125º being a normal range of motion (AAOS, 1965). The test results of hip flexion are reinforced through the study by Fração and co-authors (1999), in which classical dancers reached 126.2° with their right leg and 121.6° with their left leg. However, the data obtained in this study was lower than those found by Hamilton and collaborators (1992), in which an elite group of professional dancers reached 135º with their hip flexion.

Nevertheless, all other variables analyzed (HRH, HLH, ARH, ALH, HSL, HST) presented values above the normal range (Watkins and Clarkson, 1990), both in pre-test and in post-test results. This data may be due to the fact that the reference of normal range of motion is designed for a sedentary population, which does not practice dance. As the sample of the study consists of young and healthy women who practiced dance for three months, we can expect to achieve a greater range of joint angles involved, diverge from the standards considered normal by literature.

Data found in a study by Kwon, Ryu and Wilson (2007), in which professional and beginner dancers were evaluated, suggests that even when the professional group started out stronger and more flexible, both groups had positive gains with regards to flexibility. However, professional dancers performed the movements with more comfort and efficiency than beginner dancers. Comparing their data with the data found in this study, it is possible that beginner jazz dancers get a meaningful result in gains in range of motion, higher than expected for this population.

Despite the present study performing analysis and verifying only static and passive flexibility of joint angles, active and dynamic flexibility training was also held during the 24 jazz dance sessions. This may have influenced the results of the tests, because according to Lucas and Koslow (1984), both methods of training are effective in increasing the range of motion.

Adequate levels of strength and flexibility are fundamental to the implementation of efficient movements in dance. This is confirmed by the study of Stalder, Noble and Wilkinson (1990), in which stated that with training focused on both strength and flexibility, dancers receive a more effective and meaningful result in dance practice. One can then conclude that strength and flexibility training, combined with jazz dance classes, can assist in performance of the dancers.

According to Angioi and co-workers (2009), aspects of a dancer's performance may benefit by improving physical qualities of the dancer, such as muscle strength and flexibility. A good technical mastery of these physical qualities is essential to achieve the necessary and desired aesthetic competence during a dance performance. On the other hand, as dance is aesthetic in nature, it is extremely difficult to quantify the improvement in performance of the dancers. Even so, Brown and collaborators (2007) conducted a subjective evaluation of the ability to jump, and suggested that increasing explosive force can be useful to improve the ability to dance, and consequently, the performance of the dancer.

For Watkins and Clarkson (1990), a dance class for one or two hours is not sufficient to gradually increase strength and flexibility of each muscle group. However, the jazz dance study suggests that it is possible to achieve this increased strength and flexibility with a jazz dance class twice a week, for beginner dancers, without extra training, with only the work of these physical qualities in their own class. Then, appears that it is possible to increase muscle strength and joint range of motion simultaneously (Tables II and III). On the other hand, it is clear that regular fitness training outside of dance lessons is extremely important for professional dancers so they are better prepared for classes, rehearsals and presentations (Watkins and Clarkson, 1990).

In a study developed by Wyon and co-authors (2006), it was verified that professional dancers are stronger and more flexible than non-professional dancers or people who do not practice dance. This is mainly due to higher demand in classes and rehearsals, and may be due to a higher number of practice hours than others. This is emphasized by a Hamilton and employees study (1992), that shows that significant anatomical differences separate elite dancers from the normal population.

According to Deighan (2005), Antunes (2004), and Hamilton and collaborators (1992), articular hypermobility is not considered an advantage for dancers and is congruent with the occurrence of injuries in this population. Although this topic is not the focus of the study, it is believed that flexibility should be performed in

conjunction with muscular strength training, to ensure joint stability and, consequently, injury prevention (Ackland; Elliot; Bloomfield, 2011). This is also emphasized through the study performed by Koutedakis, Stavropoulos-Kalinoglou and Metsios (2005), in which they argue that improvements in muscular strength and ability would seem to be a way for dancers to improve their technical performance and reduce the risks that the career presents.

**Conclusions**

After analysis and discussion of the results, it is considered that 24 jazz dance sessions have a significant influence on improving flexibility in all the variables studied – as well as vertical jump strength and abdominal resistance – for beginner dancers. In all the variables presented there was a statistically significant difference with regards to gain in range of motion and muscle strength.

With respect to the explosive strength of lower limbs (VJ) and the strength of muscular endurance (AR), it is believed that jazz dance brings considerable benefits to this physical capacity. However, there was no isometric strength gains in the dancers' hands, as tested by the dynamometer.

Regarding flexibility, the dancers have achieved high performance levels in all joint angles. It is believed that the training of this physical ability has a positive effect in jazz dance classes, taking into account the need for practice, as other studies have suggested.

Nevertheless, regarding intra-class correlation coefficient (ICC), in which only HST test did not provide excellent correlation, one can see that the protocol used in class was successful for the purpose of this study.

Despite this, the study does present some limitations, mostly due to the absence of a control group, which would assist in precision and reliability of test results. The sample number (n=8) is considered low for a quantitative study, and the way the sample was selected, intentionally and not randomly, also set limitations on the results of the study.

It is believed that jazz dance can be a discipline both artistic and athletic, and it is the integration of these two elements, seemingly unrelated, which distinguishes it from other artistic forms and sports. Thus, along with the technical requirements of art, jazz dancers need to widely develop physical qualities such as strength and flexibility, in order to keep-up with the athletic demands of the sport.

It is considered that jazz dance professionals can perform a more qualified planning training programs that modify their physical qualities or to their students with the goal of improving performance. Another important factor to consider would be to increase muscle strength and joint range of motion simultaneously, to provide a more effective and meaningful result in dance classes, in addition to stabilizing the joints and preventing future injuries.

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