



Physical Fitness Profiles Across Classical Ballet, Contemporary Dance, Ballroom Dance, and Non-Dancers in Young Women

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Abstract: Herein, we compared physical fitness profiles among non-dancers and dancers practicing classical ballet, contemporary dance, and ballroom dance. Forty young women were divided into four groups: classical ballet (19.1 ± 1.7 years; BMI: 20.7 ± 1.6 kg/m²), contemporary dance (22.0 ± 3.9 years; BMI: 21.1 ± 2.6 kg/m²), ballroom dance (22.1 ± 3.5 years; BMI: 22.2 ± 3.3 kg/m²), and non-dancer controls (24.8 ± 3.3 years; BMI: 22.3 ± 2.5 kg/m²). Physical fitness was assessed using sit-and-reach, sit-up, push-up, vertical jump, flamingo balance, shuttle-run, and Borg perceived exertion tests. Non-dancers showed lower performance across all physical fitness tests than dancers, with the clearest differences observed against classical ballet and contemporary dance groups. Across dance modalities, classical ballet and contemporary dancers demonstrated superior neuromuscular fitness compared with ballroom dancers, particularly in muscular endurance, lower-limb strength, balance, flexibility, and agility. No relevant differences were observed between classical ballet and contemporary dancers. Non-dancers also reported greater perceived exertion during testing. These findings indicate modality-specific fitness adaptations and suggest that dance-related physiological demands differ according to training characteristics. The results may help coaches, dance teachers, conditioning specialists, and researchers develop targeted interventions to enhance performance, physical fitness, and long-term health outcomes among dancers and active populations.

Keywords: Physical Activity, Exercise, Athletic Performance, Muscle Strength.

1. Introduction

Although dance training leads to changes in physical fitness, fitness improvements in sports science are not equal across all modalities (Siddiqui, Nessa, & Hossain 2010). There are nearly as many dance styles as there are types of sports, and each form of dance training may involve specific musculoskeletal actions that affect the performance and health of practitioners (Lakes *et al.* 2016; Borges *et al.* 2018; Clarke *et al.* 2019). For instance, classical ballet requires muscular endurance, muscular strength, and flexibility (Motta-Valencia 2006; Letton *et al.* 2024), whereas ballroom dance requires motor coordination (Lakes *et al.* 2016), and contemporary dance requires the ability to perform a postural task concurrently with a cognitive activity (Sirois-Leclerc, Remaud, & Bilodeau 2017).

Research initiatives that elucidate the specific characteristics of different sports and physical activities are highly warranted, especially when dance is considered a non-pharmacological tool to promote health and well-being. Although the dance literature is growing, most studies are limited to the analysis of a single modality. Thus, before physiologists can design interventions to improve performance and fitness through dance exercises, the performance demands of different dance modalities must be ascertained.

Herein, the present study aimed to compare physical fitness skills between non-dancers and dance practitioners, as well as across classical ballet, contemporary dance, and ballroom dance modalities, using a validated test battery.

We hypothesized that dance practitioners would exhibit greater physical fitness skills than non-practitioners and that differences would be observed between modalities, especially when ballroom dance was compared with classical ballet and contemporary dance.

2. Methods

2.1 Subjects

After approval by the University of Cruzeiro do Sul Ethics Committee (115/2009), forty women agreed to participate in the study. All participants were previously informed about the study procedures and signed a free and informed consent form. The participants were recruited from dance schools in São Paulo, Brazil. Participants diagnosed with contusions or injuries, those using anti-inflammatory or antihypertensive medication, those with viral infections, acute allergic conditions, immune system or metabolic diseases, or other pathologies were excluded from the study.

All participants were instructed to refrain from strenuous exercise for at least 48 hours before the fitness testing session. Participants were divided into four groups of ten volunteers each based on the dance

modality they practiced: classical ballet (62.4 ± 11.0 months), contemporary dance (63.0 ± 10.6 months), ballroom dance (41.4 ± 5.4 months), and a control group of non-dancers who were classified as sedentary using the International Physical Activity Questionnaire (IPAQ).

The groups had the following characteristics (mean \pm standard deviation [SD]): classical ballet (19.1 ± 1.7 years, 20.7 ± 1.6 kg/m²), contemporary dance (22.0 ± 3.9 years, 21.1 ± 2.6 kg/m²), ballroom dance (22.1 ± 3.5 years, 22.2 ± 3.3 kg/m²), and control group (24.8 ± 3.3 years, 22.3 ± 2.5 kg/m²).

2.2 Fitness Testing Battery

Physical fitness assessment included evaluations of flexibility, muscular endurance, upper-limb strength, lower-limb strength, balance, and agility performance. The validated battery (Sakamaki 1983; Clemons 2019; Thompson *et al.* 2013) consisted of the following tests: sit-and-reach, sit-up, push-up, vertical jump, flamingo balance, and shuttle-run (Figure 1). These tests were performed according to the EUROFIT test procedures (Committee of Experts on Sports Research EUROFIT, 1987).

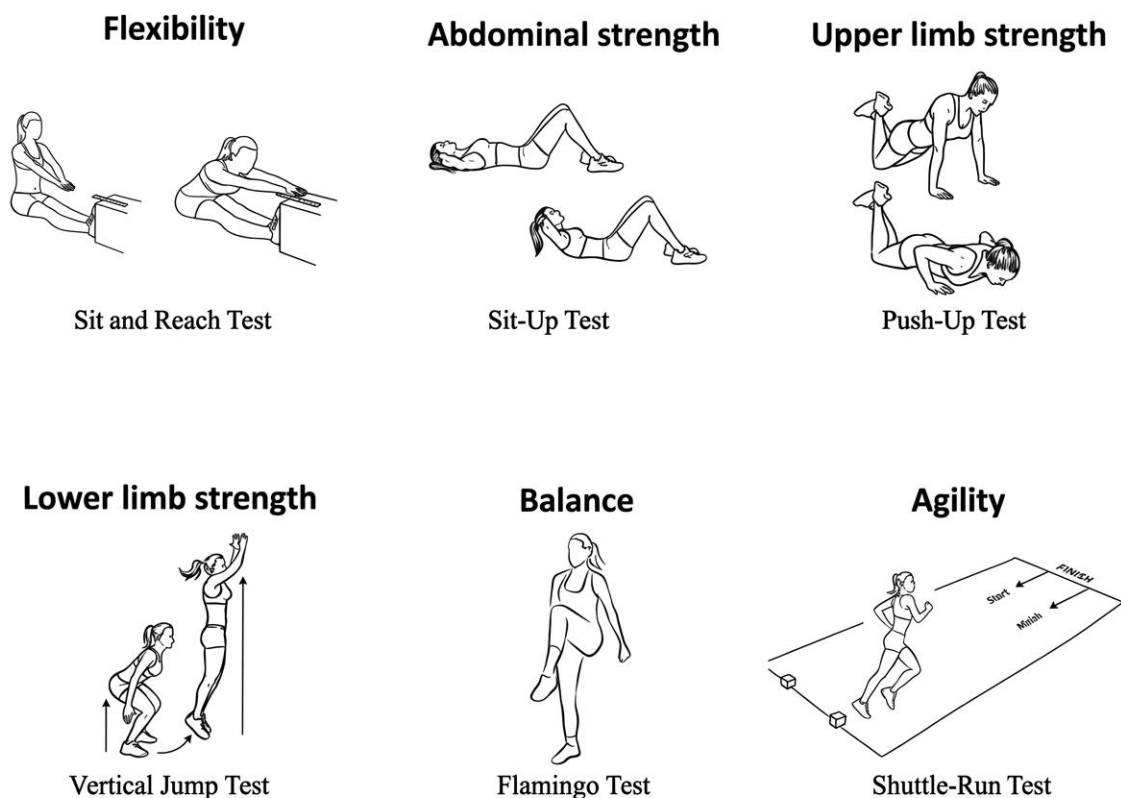


Figure 1. Representation of the physical fitness tests used in the study and their corresponding physical capacities.

2.2.1 Flexibility

Flexibility was evaluated using the sit-and-reach test. In this assessment, participants sat on a mat with their knees extended and the yardstick positioned between their legs. The participants' heels were placed at the two ends of a 30-cm taped strip. Participants were asked to reach forward slowly as far as possible and to hold the final position for 2 seconds. Their hands were overlapped and their fingers extended. The farthest point reached with the fingertips was recorded as the test result. Each participant performed three trials, and the best trial was used in the analysis (Committee of Experts on Sports Research EUROFIT, 1987; Thompson *et al.* 2013).

2.2.2 Muscle Endurance

To assess muscular endurance, abdominal muscular strength was evaluated by recording the maximum number of sit-ups performed in 60 seconds while participants lay on their backs with their heels on the mat and their knees flexed at 90°. Participants were asked to lift the trunk until their elbows made contact with their knees and then return to the supine position. Each participant performed two trials, and the best trial was used as the test result (Committee of Experts on Sports Research EUROFIT, 1987; Thompson *et al.* 2013).

2.2.3 Balance

The flamingo balance test was used to determine the ability to maintain balance on a single leg. In this test, participants bent the free leg backward and gripped the back foot with the hand on the same side. After one familiarization trial, the number of falls during 60 seconds of balancing was used as the result. The sum of attempts with both legs was calculated as the test score, with lower scores indicating better performance (Committee of Experts on Sports Research EUROFIT, 1987; Thompson *et al.* 2013).

2.2.4 Agility

Agility was measured using a shuttle-run test, in which marker cones were placed 5 meters apart. When instructed by the timer, the participant ran to the opposite marker, turned, and returned to the starting line. This procedure was repeated five times without stopping, covering approximately 50 meters in total, and the completion time in seconds was used as the

outcome (Committee of Experts on Sports Research EUROFIT, 1987; Thompson *et al.* 2013).

2.2.5 Upper-Limb Strength

A push-up test was used to evaluate upper-limb strength endurance. From a prone starting position on the floor, participants were required to perform the maximum number of push-ups as quickly as possible in 60 seconds, with a single rest period of no more than 2 seconds allowed between repetitions. The body was lowered until the elbows reached 90° and then returned to the starting position with the arms extended. The number of full repetitions completed at the 60-second mark was used as the test result (Clemons 2019; Thompson *et al.* 2013).

2.2.6 Lower-Limb Strength

A vertical jump test was used to assess lower-limb strength and power. A tape was fixed to a wall, and chalk was applied to the participant's hand to mark the jump height. The participant stood sideways to the wall with one arm raised, bent her knees, and jumped as high as possible while touching the wall with her hand. Each participant performed three vertical jump trials, and the best trial was used as the test result (Thompson *et al.* 2013).

2.3 Rating of Perceived Exertion

The perceived intensity of effort for each group was monitored using the 15-point Borg rating of perceived exertion (RPE) scale (Borg 1970). Participants were asked to answer the question, "How intense was the session?" using a visual analog scale in which 6 indicated "no exertion" and 15 indicated "maximal exertion."

2.4 Statistical Analysis

Results are expressed as the mean \pm standard deviation (SD) for 40 participants divided into contemporary dance, classical ballet, ballroom dance, and control groups. The Shapiro-Wilk test was applied to verify data normality.

For normally distributed data, ANOVA and Tukey's post-hoc test were used. For non-normally distributed data, the Kruskal-Wallis test and Dunn's post-hoc test were used. Differences were considered significant at $p < 0.05$.

Given the small sample size, effect size analyses were performed. Eta squared was used to calculate the effect size across groups and was classified as follows: 0.01 to <0.06 = small; 0.06 to <0.14 = medium; and ≥0.14 = large (Richardson, 2011). Effect sizes for comparisons between groups were assessed using Cohen's d and classified as follows: 0.2 = small, 0.5 = medium, and 0.8 = large (Cohen, 1988). Although no a priori sample size calculation was performed, the large observed effect sizes suggest adequate statistical sensitivity for detecting between-group differences.

3. Results

The physical fitness test results are presented in Table 1 as means and standard deviations (SD) for each group. The classical ballet and contemporary dance groups showed better results in all physical

fitness tests compared with non-dancers. The ballroom dance group showed no statistically significant difference from the control group only in the upper-limb strength test. Across dance modalities, the classical ballet group showed better results in the muscular endurance and lower-limb strength tests, whereas the contemporary dance group performed better in the muscular endurance test. No differences were observed between the classical ballet and contemporary dance groups in any physical fitness test (Table 1).

The data in Table 2 demonstrated large effect sizes in all eta squared analyses for the physical tests. Cohen's d analyses showed large effects when comparing the dance groups with non-dancers, except for the balance test comparison between the control and contemporary dance groups, which was classified as a medium effect (d = 0.7).

Table 1. Results of physical fitness tests applied by group.

	Non-dancers * - p<0,05	Classical Ballet & - p<0,05	Contemp.Dance	Ballroom Dance # p<0,05
Flexibility (cm)	30.0±1.3	40.4±2.5*	40.1±2.3*	37.8±2.1*
Muscle endurance (repetitions)	15.4±3.3	25.7±2.8*#	25.9±4.4*#	20.9±1.7*
Upper limb strength (repetitions)	3.2±1.9	14.7±5.2*	24.7±6.2*#	7.4±3.0
Lower limb strength (cm)	28.4±1.0	32.9±0.7*	32.2±1.1*	30.0±0.8+
Balance (attempts)	7.5±1.0	2.8±0.8*	3.0±1.2*	4.7±0.8
Agility (seconds)	9.6±0.7	8.6±0.5*	8.4±0.5*	9.0±0.5*

Values are presented as mean ± SD. * p<0.05 when compared to control group with non-dancers. # p<0.05 when compared to Ballroom Dance group. + p<0.05 when compared to Classical Ballet group

Table 2. Values for effect size analysis.

	η ²	d					
		Classical Ballet		Contemporary			Ballroom
		Control	Ballroom	Control	Ballet	Ballroom	Control
Flexibility	0.6	3.9*	0.9	4.1*	0.1	0.8	3.3*
Muscle endurance	0.7	2.8*	1.6*	2.1*	0.0	1.1*	1.9*
Upper limb strength	0.7	2.2*	1.3	0.9*	1.5	2.7*	1.3
Lower limb strength	0.8	4.5*	3.1*	2.9*	0.6	1.7	1.5
Balance	0.8	4.5*	1.9	0.7*	0.2	1.3	2.6
Agility	0.4	1.4*	0.7	1.7*	0.3	1.0	0.9*

η² - Eta squared. d - Cohen's d. *p<0.05 – Corresponding comparison presented a statistically significant difference. Eta squared classification: 0.01 - <0.06 – small; 0.06 - < 0.14 – medium; ≥ 0.14 – large (Richardson 2011). Cohen's d classification: 0.2 – small; 0.5 – medium; 0.8 – large (Cohen, 1988).

Comparisons between dance groups showed that the effect size between contemporary and ballroom dance was large for all physical fitness tests ($d > 0.8$). The effect size between classical ballet and ballroom dance was also large for all tests, except for the agility test, which was classified as a medium effect ($d = 0.7$). Comparisons between classical ballet and contemporary dance showed that only the upper-limb strength test had a large effect size ($d = 1.5$).

In the sit-up test used to evaluate muscular endurance (Figure 2a), the non-dancer group performed an average of 15 repetitions in 60 seconds, representing 5 fewer repetitions than the ballroom dance group ($p = 0.0026$; $d = 1.9$) and 10 fewer repetitions than the classical ballet ($p < 0.0001$; $d = 2.8$) and contemporary dance groups ($p < 0.0001$; $d = 2.1$). Among the dance groups, the lowest result was observed in the ballroom dance group, which performed an average of 20 repetitions, 5 fewer than both the classical ballet ($p = 0.0099$; $d = 1.6$) and contemporary dance groups ($p = 0.0069$; $d = 1.1$). The classical ballet and contemporary dance groups performed the same average number of repetitions, with no significant

difference and an insignificant effect size ($p = 0.9$; $d = 0.0$).

To assess lower-limb strength using the vertical jump test (Figure 2b), the control group jumped an average height of 28 cm, which was 2 cm lower than the ballroom dance group, showing no statistical difference but a large effect size, possibly due to the small sample size ($p = 0.6239$; $d = 1.5$). Compared with the other two modalities, the control group's jump was 4 cm lower than those of the ballet group ($p < 0.0001$; $d = 4.5$) and the contemporary dance group ($p = 0.0002$; $d = 2.9$). The ballroom dance group jumped 2 cm lower than the ballet group ($p = 0.0049$; $d = 3.1$) and the contemporary dance group ($p = 0.0752$; $d = 1.7$), with no statistical difference for the latter comparison but a large effect size. The ballet and contemporary dance groups presented an average jump height of 32 cm, with no statistical difference between them and a medium effect size ($p > 0.9999$; $d = 0.6$). In the upper-limb strength assessment using the push-up test (Figure 2c), the group that performed the most repetitions in 60 seconds was the contemporary dance group, with an average of 24 repetitions.

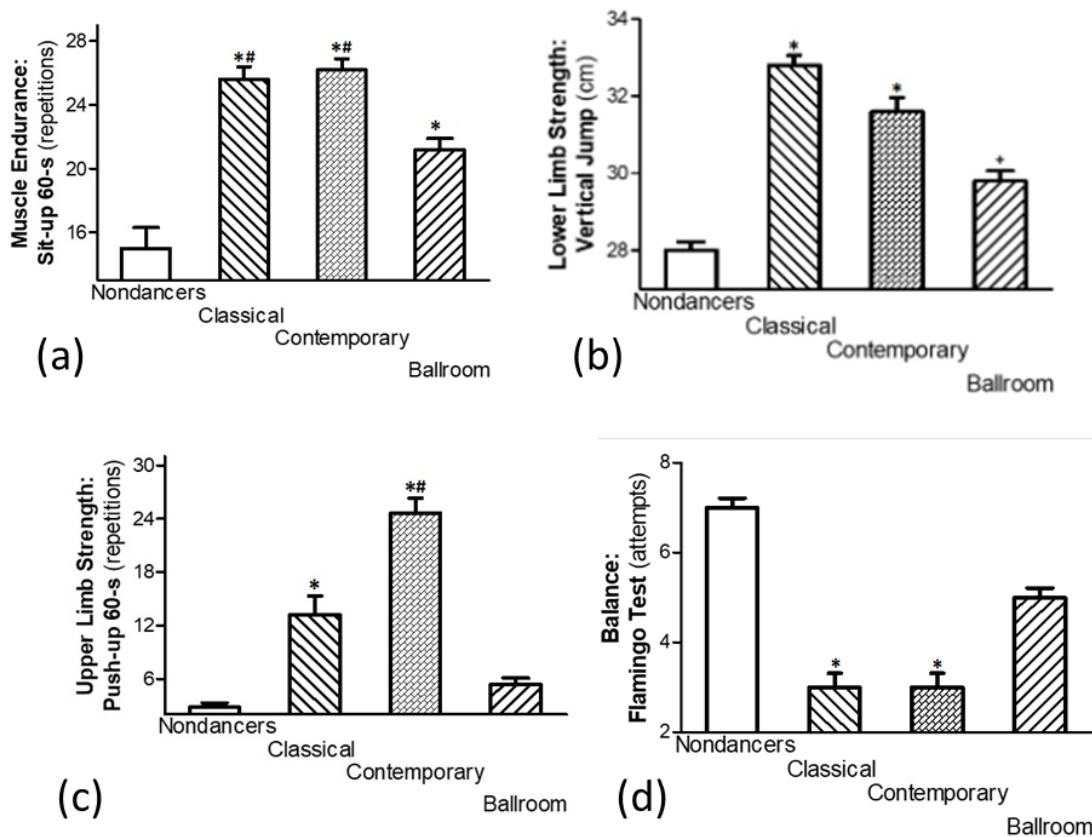


Figure 2. Outcomes of the fitness performance tests for muscular endurance (a), lower-limb strength (b), upper-limb strength (c), and balance (d). Data are presented as mean \pm SEM; * $p < 0.05$ compared with the control group; # $p < 0.05$ compared with the ballroom dance group; + $p < 0.05$ compared with the classical ballet group.

This represented 10 more repetitions than the ballet group, with no statistical significance but a large effect size ($p = 0.4126$; $d = 1.5$), 17 more than the ballroom group ($p = 0.0021$; $d = 2.7$), and 21 more than the control group ($p < 0.0001$; $d = 0.9$). The classical ballet group performed 7 more repetitions than the ballroom dance group, with no statistical difference but a large effect size ($p = 0.4778$; $d = 1.3$), and 11 more repetitions than the control group ($p = 0.0046$; $d = 2.2$). Comparisons between the control and ballroom groups ($p = 0.6455$; $d = 1.3$) and between the ballet and contemporary groups ($p = 0.4126$; $d = 1.5$) showed no statistically significant differences despite large effect sizes.

In the balance assessment using the flamingo test (Figure 2d), the best result was represented by the fewest attempts to reposition oneself. The control group repositioned themselves an average of 7 times during the 60-second period, representing 4 more attempts than the classical ballet group ($p < 0.0001$; $d = 4.5$) and the contemporary dance group ($p < 0.0001$; $d = 0.7$), and 3 more attempts than the ballroom dance group, in this case without statistical significance but with a large effect size ($p = 0.1515$; $d = 2.6$).

The ballroom dance group performed at least one more attempt than the classical ballet ($p = 0.0535$; $d = 1.9$) and contemporary dance groups ($p = 0.1441$; $d = 1.3$), with both comparisons showing no statistical significance but large effect sizes. There was no difference between the classical ballet and contemporary dance groups, and the effect size was considered small; both groups performed an average of 3 trials each ($p > 0.9999$; $d = 0.2$).

The sit-and-reach test was used to assess participants' flexibility (Figure 3a). The control group achieved the shortest distance, 30 cm, which was 7 cm less than the ballroom dance group ($p = 0.0196$; $d = 3.3$) and 10 cm less than the classical ballet ($p < 0.0001$; $d = 3.9$) and contemporary dance groups ($p = 0.0001$; $d = 4.1$). Among the dance groups, the 3-cm difference between the ballroom dance group and the ballet ($p = 0.9047$; $d = 0.9$) and contemporary dance groups ($p > 0.9999$; $d = 0.8$) did not reach statistical significance but showed large effect sizes. Moreover, there was no statistically significant difference between the classical ballet and contemporary dance groups, and the effect size was considered small ($p > 0.9999$; $d = 0.1$).

Agility was assessed using the shuttle-run test, which considers task completion time (Figure 3b). The non-dancers took the longest time to complete the test, with an average of 9.6 seconds, which was 0.6 seconds slower than the ballroom dance group ($p = 0.0196$; $d = 0.9$) and 1 second slower than the classical ballet group ($p < 0.0001$; $d = 1.4$) and the contemporary dance group ($p = 0.0001$; $d = 1.7$). In the comparison between dance modalities, the ballroom dance group was the slowest, 0.6 seconds slower than the contemporary dance group ($p > 0.9999$; $d = 1.0$) and 0.4 seconds slower than the ballet group ($p = 0.9047$; $d = 0.7$), both without statistical significance and with large and medium effect sizes, respectively. Between the classical ballet and contemporary dance groups, the average completion time did not differ significantly, and the effect size was considered medium ($p > 0.9999$; $d = 0.3$).

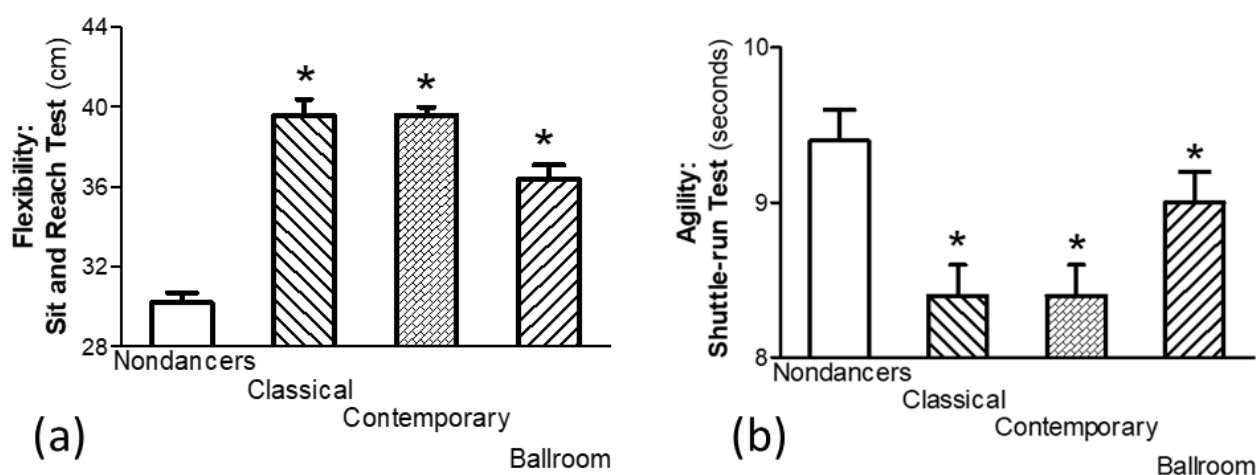


Figure 3. Outcomes of the fitness performance tests for flexibility (a) and agility (b) Data are presented as mean \pm SEM; * $p < 0.05$ compared with the control group.

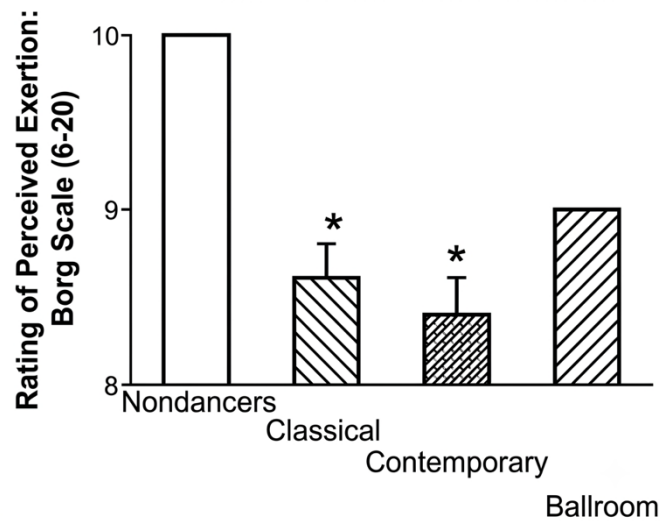


Figure 4. Rating of perceived exertion. Values are presented as mean \pm SEM; * $p < 0.05$ compared with the control group.

Finally, the Borg scale was used to assess perceived exertion during the tests (Figure 4). The control group reported higher perceived exertion, corresponding to an intensity of 10 on the scale. This was one point higher than the ballroom dance group, with no statistical difference but a large effect size ($p = 0.1666$; $d = 1.4$), and 2 points higher than the classical ballet ($p = 0.0023$; $d = 1.6$) and contemporary dance groups ($p = 0.0006$; $d = 1.7$). Among the dance groups, the ballroom group reported 9 points on the scale, one point higher than the classical ballet ($p > 0.9999$; $d = 0.8$) and contemporary dance groups ($p = 0.5429$; $d = 0.9$), both without statistical significance but with large effect sizes. Between the ballet and contemporary dance groups, the reported values did not differ significantly, and the effect size was considered small ($p > 0.9999$; $d = 0.2$).

4. Discussion

To our knowledge, this is the first study to assess performance in field-based physical fitness tests across different dance modalities in healthy women. Regarding muscular endurance, muscular strength, balance, agility, and flexibility, ballroom dance practitioners had lower physical fitness compared with classical ballet and contemporary dance practitioners.

Improvements in fitness may not be equal across all forms of sport, and this could affect athletes' health in the medium to long term (Siddiqui, Nessa, & Hossain, 2010; Lakes *et al.* 2016; Lopez *et al.* 2023). Thus, from a practical perspective, lower fitness levels may be associated with negative health effects, such as decreased energy expenditure during daily activities and

increased post-exercise soreness, according to previous literature (Ruiz *et al.* 2011; Sánchez-Sánchez *et al.* 2024). Reduced muscular endurance can also lead to inappropriate posture, back problems, and poorer tolerance to muscular fatigue and, in the long term, may increase the risk of falls, leading to loss of autonomy (Swain & Redding, 2014; Papadopoulou *et al.* 2021).

In our study, classical ballet and contemporary dancers showed higher flexibility values than ballroom dancers. Reduced flexibility may affect dancers' health because low flexibility can lead to reduced range of motion and function, impaired coordination, and increased risk of joint and muscle strains (Siddiqui, Nessa, & Hossain 2010). In fact, data from longitudinal Finnish research suggest that hamstring flexibility was one of the best explanatory factors for adult health-related fitness, and stretching exercise may enhance postural stability and balance (Mikkelsen *et al.* 2006; Costa *et al.* 2009; Garber *et al.* 2011).

Our findings also indicate that, compared with the control group, dancers had higher physical fitness skills. Moreover, the rating of perceived exertion during the fitness tests was higher in participants from the control group than in the dance groups. These data suggest that classical ballet and contemporary dancers showed higher performance in several field-based fitness assessments compared with non-dancers. On this basis, future studies should compare the physical demands and physiological adaptations of dance modalities, with specific emphasis on skeletal, metabolic, and cardiovascular effects.

Regarding the potential long-term benefits of physical fitness, evidence suggests that exercise

training may have a positive effect on fracture risk, especially by reducing the risk of falling, which is associated with muscular strength and postural balance (Hourigan *et al.* 2008; Karlsson 2004; Papadopoulou *et al.* 2021). Based on this perspective, we hypothesized that the higher postural balance performance observed in classical ballet and contemporary dance practitioners, combined with parallel gains in muscular strength, may be associated with physical capacities commonly linked to fall prevention in previous literature.

These findings may have implications for functional health outcomes; however, longitudinal and interventional studies are necessary to determine whether these performance differences would, in fact, reduce fall or fracture risk. Corroborating this perspective, classical studies have shown that baseline muscular strength, endurance, and flexibility predict the future occurrence of tension neck and low back pain in adults (Barnekow-Bergkvist *et al.* 1998; Leino, Aro, & Hasan 1987). In addition, recent literature has shown that physical fitness may be a robust marker of current health status and a lower risk of incident and chronic conditions in the general population (Lang *et al.* 2024; Tomkinson *et al.* 2025).

For instance, a 25-year follow-up study that investigated associations between physical fitness characteristics and musculoskeletal problems showed that adequate flexibility and endurance strength may help decrease the risk of tension neck symptoms (Mikkelsen *et al.* 2006). However, larger prospective studies are needed to support this hypothesis.

The strengths of this study include its standardized testing procedures and multidimensional comparison of different dance modalities using validated field-based fitness assessments. However, some limitations should be acknowledged, including the relatively small sample size, cross-sectional design, and lack of objective assessment of physical activity levels in the control group. In addition, differences in age and dance experience between groups, the shorter practice duration among ballroom dancers, and the use of BMI as the sole body composition measure may represent potential confounding factors. Finally, multiple comparisons and large observed effect sizes should be interpreted cautiously.

5. Conclusion

Classical ballet and contemporary dance practitioners demonstrated higher performance in neuromuscular-related field tests than ballroom dancers

and non-dancers, particularly for muscular endurance, lower- and upper-limb strength, balance, flexibility, and agility. Ballroom dancers showed intermediate results, suggesting that this modality may provide fitness benefits compared with non-dance participation but may not impose the same breadth of neuromuscular demands observed in classical ballet and contemporary dance. The similar performance between classical ballet and contemporary dancers indicates that both modalities may promote comparable physical fitness profiles despite differences in technical and artistic requirements. Higher perceived exertion among non-dancers further supports the functional advantage associated with regular dance practice. These findings contribute to the characterization of modality-specific fitness profiles in dance and may assist coaches, dance teachers, and conditioning specialists in designing targeted training programs. In particular, ballroom dancers may benefit from supplementary strength, balance, agility, and flexibility training. However, because this study used a cross-sectional design and included a relatively small sample, the results should be interpreted as associative rather than causal. Future longitudinal and controlled intervention studies are warranted to determine whether specific dance modalities directly induce distinct neuromuscular, performance-related, and health-related adaptations over time in dancers and physically active young women.

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Author Contribution Statement

Jamila Silva: Conceptualization, Methodology, Validation, Formal analysis, Writing – original draft. Paulo Barbosa de Freitas Júnior: Methodology, Writing – original draft. Leandro Borges: Writing – review & editing. Alexandre Dermargos: Writing – review & editing. Elaine Hatanaka: Writing – review & editing. All the authors read and approved the final version of the manuscript.

Ethics Approval Statement

Ethics approval was obtained from University of Cruzeiro do Sul Ethics Committee (115/2009).

Participant Consent

Written informed consent was obtained from all participants before the commencement of the study.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this article.

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