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Technical Note

Compressive Pantyhose Mitigates Muscle Fatigue in Ballet-Specific Test: A Pilot Study

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Abstract

International Journal of Exercise Science 18(2): 92-106, 2025. https://doi.org/10.70252/WDGS4753 Compression garments, utilized in sports and exercise for performance enhancement and recovery, lack sufficient well-controlled studies to overcome any potential placebo effect. Therefore, we tested whether wearing compressive pantyhose (CP) during the Ballet-specific aerobic fitness test (BAFT) would influence performance, recovery, physiological, and perceptual indicators. Additionally, this pilot study tested the feasibility of the research procedures and informed adjustments for the main study. Nine young classical ballerinas attended two sessions on different days: a) wearing CP (pressure of 20-30 mmHg) or b) wearing a placebo pantyhose ([PLA] no compression, containing an illusory effect) during the BAFT. We assessed heart rate (HR) and rating of perceived exertion (RPE) during the BAFT, perceived recovery (PRS), lower-limb delayed onset muscle soreness (DOMS) at Pre and 24 h Post, and standing heel-rise test performance at Pre, 30 min, and 24 h Post. No variables differed ($p>0.05$) between CP and PLA (e.g., HR mean over 5 BAFT phases: 178±14 bpm vs. 179±17 bpm, $p=0.63$; RPE 30 min post: 9.1±0.8 vs. 9.1±0.8 arbitrary units, $p=0.94$). However, wearing CP promoted attenuation in acute fatigue, while PLA showed a performance decrement ($p<0.05$) 30 min Post in the standing heel-rise test: CP 30.2±6.0 to 22.8±7.5 repetitions and PLA 36.2±11.7 to 22.9±6.3 repetitions. We conclude that CP may mitigate acute fatigue in the triceps *surae* muscle of amateur classical ballet dancers, making it relevant for their acute recovery, particularly in cases involving multiple daily performances. Additionally, this pilot study confirmed the feasibility of the procedures.

Keywords: Dance, compression garment, performance, recovery

Introduction

Classical ballet is characterized by intermittent movements that demand high levels of muscular strength, power, and flexibility, along with significant reliance on both aerobic and anaerobic

energy production.[1,2] Besides technical and expressive ability, top-level classical ballet demands good physical and physiological preparation for high-level performance, as well as fast recovery between sessions to meet the demands of choreography during the season.[1,2] However, it has been reported that ballet dancers usually have a lower fitness level (e.g., maximal oxygen consumption and muscular strength) compared to other types of athletes and dancers.[1,3] Low level of fitness combined with exposure to high physical demands, and insufficient recovery between sessions, can lead to accumulated fatigue, reduced technical quality of movements, and an increased risk of injury among dancers.[3,4]

To assess performance and recovery in dancers, the Ballet-specific Aerobic Fitness Test (BAFT) has been developed and validated as a tool to simulate the physical demands of classical ballet. [5] This test is increasingly used in research to evaluate dancers' fitness and recovery strategies, providing an ecologically valid measure of performance and fatigue in this population.

To optimize performance and recovery in physical activities and sports, various strategies, including the use of compressive garments, have been explored as potential alternatives to enhance physical/physiological performance and expedite athlete recovery.[6] The potential mechanisms behind how compression garments improve performance are still unclear, and there is controversy about their real effectiveness.[6] Potential mechanisms include improved venous blood flow at rest, during exercise, and recovery from a physiological challenge[7]; improved circulation and reduced muscle oscillations, lowering energy expenditure at submaximal running speeds[8]; reduced histological damage and less delayed onset muscle soreness (DOMS)-related injury, as assessed via *vastus lateralis* biopsies.[9] These benefits might be particularly relevant for ballet dancers, whose demanding routines stress the musculoskeletal system.[1] Moreover, the similarity of compression garments to standard ballet pantyhose enhances their feasibility for this population.

However, the use of compression garments in studies on exercise performance and both physiological and perceived recovery is challenged by potential placebo effects and difficulty in blinding participants.[7,10] A recent systematic review showed that all studies analyzed did not properly blind participants, leading to potential placebo effects.[7] Furthermore, there is a lack of research on the effects of compressive garments specifically for classical ballet dancers, which could provide potential benefits, particularly when facing multiple performances in a single day. Therefore, we tested whether wearing compressive pantyhose (CP) during the BAFT would influence performance as well as physiological and perceptual indicators of recovery in amateur classical ballet dancers. As mentioned, the BAFT is a validated and widely accepted test for assessing dancers.[5] For this study, we designed a robust placebo condition to account for potential placebo effects. Our hypothesis was that wearing CP during the activity would improve acute recovery. Additionally, another aim of this pilot study was to test the feasibility of the research procedures and to guide adjustments for the main study.

Methods

Participants

Originally, this study was designed to include a larger sample size. However, due to practical constraints, such as difficulty in recruiting participants within the desired timeframe, the study was adapted to function as a pilot study. While the hypothesis remained, the smaller sample size required a shift toward exploratory objectives, with an emphasis on descriptive statistics and effect sizes rather than hypothesis testing.

Initially, 11 women participated on this pilot study, however due to attrition nine amateur classic ballet dancers (age: 22 ± 5 years; 8.7 ± 2.6 years of ballet experience; height: 160 ± 0.05 cm; body mass: 54 ± 6.7 kg; 22 ± 3.9 of % body fat) completed all sessions. Participants were categorized as amateur based on their lack of professional income from ballet. Their training included two 1-hour ballet sessions per week and participation in other activities such as contemporary ballet, tap dancing, and jazz, with similar frequency and duration. Half of the participants reported competing in ballet, but no competitions were ongoing during the data collection period, as it coincided with their off-season. Body fat percentage was estimated based on skinfold measurements at the triceps, suprailiac, and thigh.[11] The participants' peak oxygen consumption (VO_2peak) assessed by an indirect calorimetry system (Medgraphics VO2000) using a treadmill ramp test[12] was 39.2 ± 4.5 $mL.kg^{-1}.min^{-1}$. Participants were included according to the following criteria: healthy, without current osteomuscular and dermatological injuries, did not report to be in the menstrual period, did not use nutritional supplements or other potentiating recovery or performance enhancement strategies (e.g., massage therapy, cryotherapy, compression garments, or ergogenic aids like caffeine or creatine), and have at least four years of ballet experience. All participants provided their written informed consent, which was approved by the Local Ethics and Research Committee (4.493.200/2021). This study was performed in accordance with the Declaration of Helsinki and all methods conform to the ethical standards of the International Journal of Exercise Science.[13]

Protocol

Figure 1 shows the experimental design of the study. Familiarization occurred over three days (48 h apart): on Day 1, participants learned about perceptual measurements, had anthropometric data collected, and performed the standing heel-rise test (SHRT). On Day 2, they were introduced to the pantyhoses (not worn), watched the BAFT video, performed the VO_2peak test, and the SHRT. On Day 3, they performed the BAFT and SHRT, with perceptual measurements applied on Days 2 and 3. After the familiarization, each participant performed the BAFT in two separate sessions, seven days apart, in a counterbalanced randomized crossover design: 1) wearing a CP or 2) a placebo pantyhose (PLA). Each participant performed all experimental conditions individually to prevent influence from others participants. Performance, without stockings, on SHRT was measured at Pre, 30 min Post, and 24 h Post-BAFT following both conditions, (CP and PLA). Perceived recovery (PRS) and DOMS scores were registered at Pre and 24 h Post-BAFT, only. Mean and peak heart rate (HR) and rating of perceived exertion (RPE) were measured throughout the five phases of the BAFT. All tests were conducted by the same researcher, at the same location (temperature ≈ 23.3 ± 2.2 °C), and time of day.

Participants were instructed to wear matching ballet attire, including flat ballet shoes without tips provided by the researcher, for both sessions. The participants were instructed to abstain from consuming alcohol, dietary supplements, analgesic, and anti-inflammatory drugs, and engaging in strenuous physical activity beyond their usual ballet session in the week preceding the experiment, as well as maintain their usual diet, during the evaluation period and the day prior. Food and exercise recalls were implemented to gather data, and the participants were instructed to provide a repetition of their previous records during the second session. *Ad libitum* water intake was permitted before and after the execution of the BAFT, but not during the test.

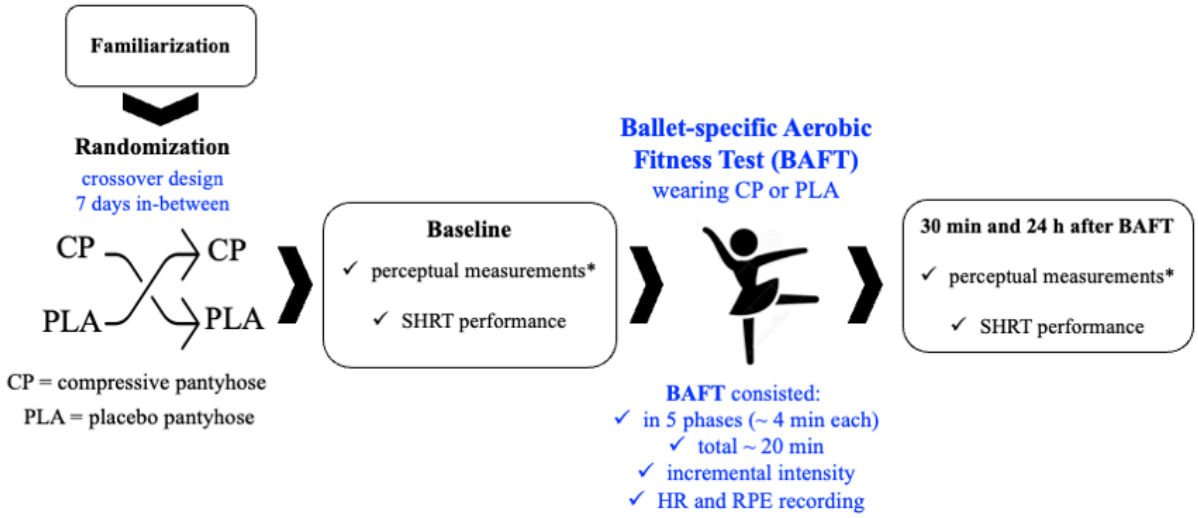

Figure 1. Experimental design of the study. Perceptual measurements* PRS = perceived recovery status and DOMS = delayed onset muscle soreness; SHRT = standing heel-rise test; HR = heart rate; RPE = rating of perceived exertion; n = 9.

In the CP session, participants wore a "Basic Medical Compression Stocking" (Sigvaris®, Brazil) type pantyhose in beige color, with a constant internal pressure of 20-30 mmHg as reported by the manufacturer, composed of 73% polyamide and 27% elastane. This specific choice was made because it closely resembles the type commonly worn during ballet classes. In the PLA session, participants wore a typical ballet pantyhose (Ultra Soft, Capézio®, Brazil) with no compression, composed of 85% polyamide and 15% elastane, also in beige color, as commonly used in ballet classes. To account for the potential placebo effect associated with compression garments, [7,10] participants were informed that both types of pantyhose (CP and PLA) might have beneficial effects on their performance and recovery. To create the impression that the PLA pantyhose might influence performance/fatigue through a 'warming effect,' they were marked with several vertical, discontinuous lines of ink on the inner face, extending from the top of the thigh to the ankle. This was intended to make the PLA pantyhose appear unconventional and to promote an illusionary effect in the PLA condition, while aiming to maintain comparable belief between conditions (i.e., an effective placebo condition). Figure 2 displays images of the CP and PLA pantyhose used in this study.

Both pantyhose conditions (CP and PLA) were worn only during the BAFT exercise sessions and not during baseline measurements, SHRT performance, or any recovery assessments. Participants were instructed to gradually unroll the pantyhose while alternately dressing each leg in small increments, rather than fully putting on one leg before starting the other. They were also advised to ensure the pantyhose was evenly distributed over their skin as much as possible.

Figure 2. Pantyhoses used in the experimental conditions of the research. From left to right: posterior view of the placebo pantyhose, reverse side of the placebo pantyhose, posterior view of the compressive pantyhose.

It is worthwhile to mention that this study involved ethical considerations with elements of deception to maintain the validity of the placebo control, as participants were not informed about the true nature of the CP and PLA conditions until the completion of the study. After all data were collected, an informative session was conducted to explain the true purpose and design of the research to the participants.

The BAFT is a four-minute ballet sequence consisting of five phases that gradually increase in intensity. Each phase corresponds to the rhythm, amplitude, and complexity of the musical accompaniment and movements. The participant is expected to maintain technical quality and rhythm throughout the choreography, and the test is stopped when the participant can no longer do so. Test-retest of the BAFT has indicated high correlation of mean oxygen consumption values ($r = 0.998$, $p < 0.001$).[5] The BAFT allows dancers to meet the specific demands of class and/or performance seasons and has been recommended as physical training for classical ballet dancers.[5]

In the present study, participants were instructed to prioritize technical and rhythmic quality while performing the BAFT. Although the BAFT is an incremental test with five phases of increasing intensity, participants were allowed to adjust their pace to maintain performance quality. This adjustment was closely monitored to ensure that all participants followed a standardized protocol. Additionally, for the purpose of this study, the songs used in the BAFT

were combined into a single track, with a 20 s interval between the five phases. The purpose of the 20 s interval was to provide participants with time to transition to the next phase and record their RPE scores. To ensure equal demands in both CP and PLA sessions, the number of repetitions of choreographic sequences performed at each phase was meticulously recorded. During the BAFT, participants were motivated by a consistent auditory cue, and the remaining time for each phase was audibly announced at 1 min intervals. In phases 4 and 5 the time remaining was announced more frequently, with 30 s intervals. This standardized approach ensured that participants remained well-informed about the time constraints.

We used the SHRT to assess the strength and endurance of the calf muscles, which are critically engaged in ballet dancing during jumps, *relevés*, and *pointe*.[1,2] The SHRT is a valid and reliable test to measure triceps *surae* muscle fatigability that is straightforward and easy to administer, making it suitable for our study.[14] Performance was evaluated Pre, 30 min Post, and 24 h Post-BAFT by the number of repetitions performed on the SHRT. These time points assessed immediate and delayed physiological and fatigue/recovery responses, commonly used in exercise science.[15] They offer insights into acute effects and short-term recovery, particularly relevant to the typical 24 h interval between ballet performances, aligning with real-world conditions for dancers. The SHRT was performed on a haberometer, a piece of equipment consisting of a rod and a foot positioning device attached to a platform, both were adjustable, a full description of the equipment and test is available in Haber 2004.[14] Participants were instructed to position the haberometer in an upright posture extend their dominant leg, maintain the contralateral leg suspended, and a flat hand against the wall for balance. Afterwards, following a rhythm of 46 beats per minute, the dancers were instructed to sequentially perform a heel raise. A complete heel raise consisted of lifting the heels until the navicular bone aligned with the stem of the apparatus, followed by lowering their heels back down to touch the platform of the device, repeating this movement successively. The test was interrupted if volunteers could not maintain the rhythm, reach the established height, or compensatory movements were exhibited. Only valid repetitions were recorded, correct repetitions was noted. The dancers performed the SHRT in both conditions (i.e., CP and PLA) without pantyhose.

To assess a physiological measurement of performance, in both conditions, HR was continuously recorded during the BAFT using wireless HR monitors (Polar Team System Pro®, Kempele-Finland). The data were transmitted to a computer and analyzed using commercial software (POLAR Team2, version 1.4.5) to calculate the mean and peak HR for each phase of the test.

The RPE scale ranging from 0 to 10, where 0 corresponds to “rest” and 10 “maximal” effort,[16] was assessed after each phase of BAFT and 30 min Post-BAFT in both CP and PLA conditions.

To ensure consistent recovery conditions prior to both sessions, we recorded both (PRS and DOMS) at baseline and 24 h Post-BAFT and data were reported as arbitrary units (AU). The dancers evaluated their PRS using a visual scale ranging from 0 to 10, where 0 indicated a state of "very poor recovery and extreme fatigue", and 10 indicated a state of "very good recovery and high energy".[17] Additionally, dancers indicated the level of DOMS in their lower limbs using a

visual numerical scale ranging from 0 (no soreness) to 10 (maximum soreness), as indicated.[18] The scale included faces depicting different levels of pain. The level of DOMS was self-evaluated by the participants touching their thigh and calf muscles with both hands, sitting in a relaxed position. To account for individual variances in the onset of DOMS, this subjective measure took into consideration the personal experience of each participant, providing a tailored assessment of DOMS. The 24 h interval reflects the typical ballet schedule, where performances often occur on consecutive days with at least 24 h between shows for adequate rest and recovery, ensuring the measurement aligns with real-world conditions for dancers.

Due to concerns regarding the possible influence of placebo or nocebo effects in studies involving ergogenic aids, we included the following questions in our registration process: Prior to the BAFT, while wearing the pantyhose, participants were asked the following questions: 1) *Do you believe that wearing this pantyhose will improve your performance during the BAFT today?* 2) *Do you believe that wearing this pantyhose will improve your recovery for the SHRT tomorrow?*

We used the method of sequential random allocation to determine the order of administration of treatments CP and PLA for each participant. Prior to the start of the study, a random sequence was generated, consisting of an equal number of treatments CP and PLA. Each participant received both treatments at different times, following the order established by the random sequence. In this way, the order of treatment administration was determined randomly, reducing the risk of selection bias and ensuring the validity of the study. One researcher was responsible for allocation processes and was not involved in testing the participants. The researcher responsible for testing the participants did not have access to the randomization codes until the end of the study, to ensure that there was no influence on the allocation process. Due to the impossibility of performing a 'double blind' experiment in this study, our intention with the PLA condition was to create a placebo condition that closely resembled the active treatment. Our aim was to ensure that participants believed both conditions would be beneficial to performance and recovery.

Statistical Analysis

The Friedman test was used to compare results for each time point for peak and mean HR, RPE, PRS, DOMS, and SHRT performance, followed by Duun's multiple comparisons test. Also, a linear regression analysis of RPE was conducted. The effect size (ES) of Cohen's d was calculated, and were classified as large (≥0.8) , medium (0.8-0.5) and small (≤0.2).[19] The significance level (alpha) was set at 0.05. A priori analysis of sample size determination revealed that 14 subjects in crossover design would be sufficient to achieve a power of 0.8 considering a large ES. This approach was selected in accordance with recommendations[20] of priori sample size estimations, the power analysis was conducted considering values reported by previous studies involving the use of compression garments across various measurements.[21,22] However, we haven't achieved the recommended number of individuals. Due to the low number of individuals in this study we calculated the specific power analysis achieved in each comparison between CP and PLA. Power analysis was performed using the software G*Power (version 3.1).[23] All data are expressed as mean ± standard deviation (SD).

Results

Figure 3 and Table 1 show the results of the SHRT repetitions at Pre, 30 min, and 24 h Post-BAFT.

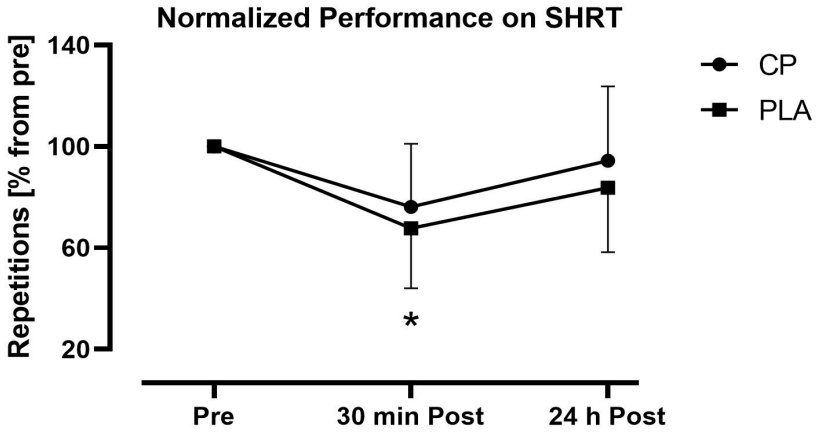

Figure 3. Standing heel-rise test (SHRT) repetitions (relative to the Pre) at Pre, 30 min and 24 h Post the Ballet-Specific Aerobic Fitness Test (BAFT), with the participants (n = 9) wearing compressive (CP) and placebo (PLA) pantyhose. * Significant difference (p = 0.01) to Pre. Data are expressed as mean ± SD.

Table 1. Repetitions on Standing heel-rise test (SHRT).

	Pre-BAFT	**30 min Post-BAFT**	**24 h Post-BAFT**
CP	30.2 ± 6.0	22.8 ± 7.5	28.3 ± 9.6
PLA	36.2 ± 11.7	22.9 ± 6.3*	28.1 ± 7.8

Ballet-Specific Aerobic Fitness Test (BAFT); CP (compressive pantyhose); PLA (placebo); *Significant difference to Pre; n = 9; Data are expressed as mean ± SD.

Table 2. Effect Size Analysis of Repetitions in the Standing Heel-Rise Test (SHRT).

		CP			PLA		
		Pre	30 min Post	24 h Post	Pre	30 min Post	24 h Post
CP	Pre	0.00 *null*	-0.99 *Large*	-0.20 *small*	0.51 *medium*	-1.16 *large*	-0.27 *Small*
	30 min Post		0.00 *Null*	0.58 *medium*	1.15 *large*	0.02 *null*	0.68 *Medium*
	24 h Post			0.00 *null*	0.68 *medium*	-0.86 *large*	-0.03 *Null*
PLA	Pre				0.00 *null*	-2.10 *large*	-1.04 *Large*
	30 min Post					0.00 *null*	0.67 *Medium*
	24 h Post						0.00 *Null*

Pre, 30 min and 24 h Post-BAFT (Ballet-Specific Aerobic Fitness Test); CP (compressive pantyhose); PLA (placebo); Data expressed as Cohen's d values.

Table 2 presents the ES analysis of repetitions in the SHRT. The Friedman test revealed a significant difference among the data (Friedman statistic = 17.35; p = 0.00). Post-hoc Dunn's

multiple comparisons indicated that this difference was attributed to a lower number of repetitions during the SHRT performed in the PLA condition at 30 min Post compared to Pre ($p = 0.01$).

Figure 4 shows the results of the peak (A) and mean (B) HR during the BAFT phases. The peak and mean HR during the BAFT did not differ ($p > 0.05$) between CP (mean HR = 178 ± 14 bpm or 90 ± 3% of peak HR) and PLA (mean HR = 179 ± 17 bpm or 90 ± 4% of peak HR) for all phases of the BAFT (Figure 4). The mean HR during phase 5 of the BAFT was 192 ± 12 bpm in the PLA and 189 ± 12 bpm in the CP. According to the HRmax equation[24] (i.e., 208 – 0.7 x age) the BAFT elicited ≈ 99% HRmax for both PLA and the CP conditions.

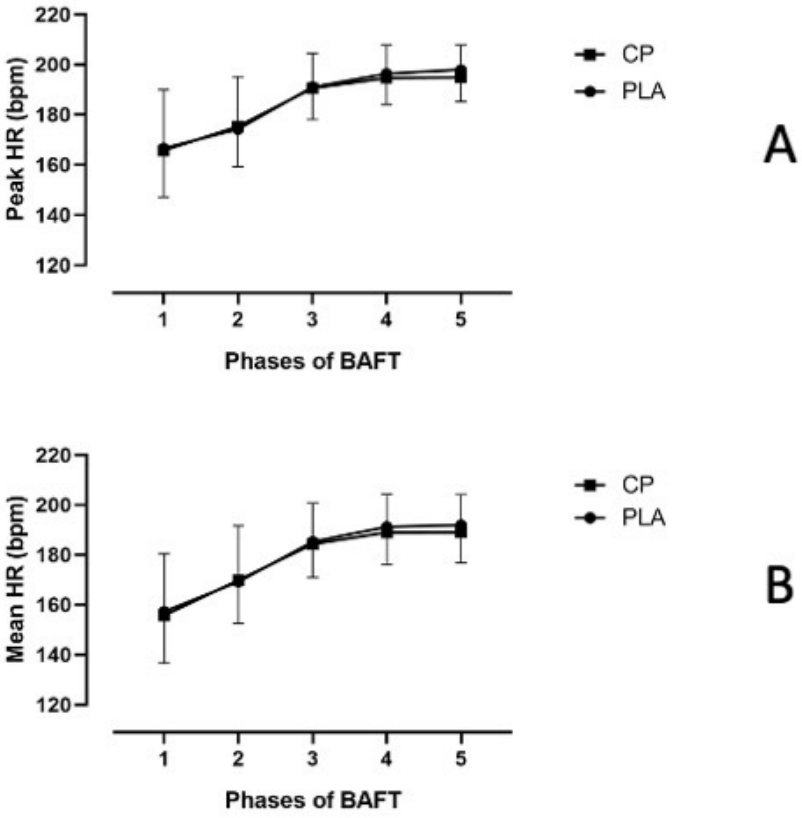

Figure 4. A: Peak heart rate responses (HR) during the different phases of the Ballet-specific aerobic fitness test (BAFT); B: mean HR during different phases of BAFT; PLA: Placebo; CP: Compressive pantyhose. Data are expressed as mean ± SD; n = 9.

RPE values did not differ in each phase of BAFT ($p > 0.05$) between CP (phase 1: 2.7 ± 1.1; phase 2: 4.3 ± 1.0; phase 3: 6.3 ± 1.3; phase 4: 8.1 ± 0.9; phase 5: 9.8 ± 0.8; 30 min Post 9.1 ± 0.8) and PLA (phase 1: 2.7 ± 1.1; phase 2: 4.4 ± 0.9; phase 3: 6.3 ± 1.2; phase 4: 8.4 ± 0.9; phase 5: 9.5 ± 0.8; 30 min Post 9.1 ± 0.8). The linear regression analysis of RPE showed that the slope coefficient was significantly different from zero for both conditions (slope = 1.787; $p < 0.01$). However, no significant differences between conditions on y-intercepts ($p = 0.84$) and slope coefficients ($p = 0.86$) were observed.

Figure 5 shows the linear regression of RPE in both conditions.

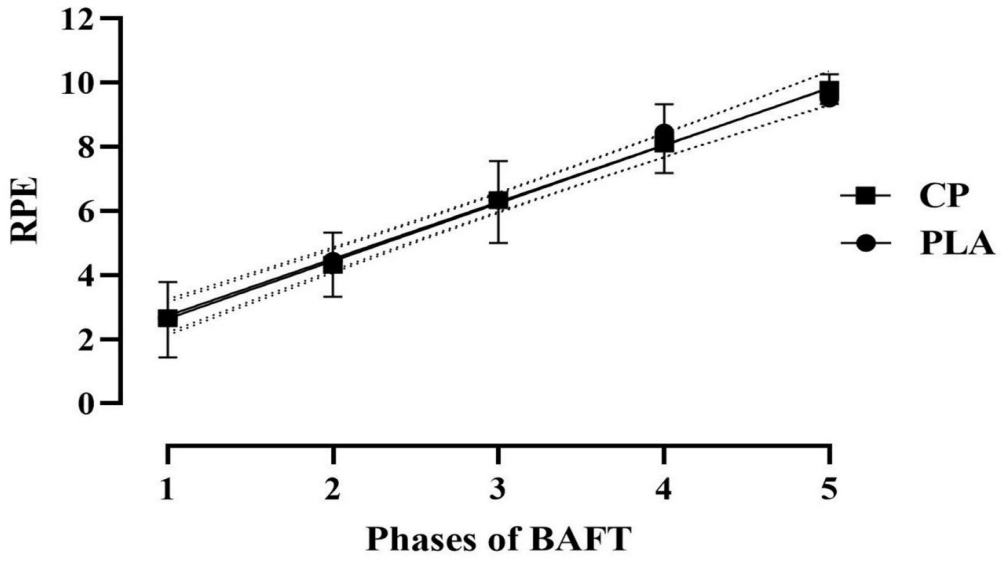

Figure 5. Linear regression of RPE (arbitrary units) during BAFT execution. Slopes are significantly different from zero ($p < 0.01$). There are no differences between slopes ($p = 0.86$) or intercepts of groups ($p = 0.84$). Data are expressed as mean ± SD. Dashed lines correspond to the 95% confidence interval. CP (compressive pantyhose); PLA (placebo).

The scores regarding both PRS and DOMS did not differ ($p > 0.05$) between CP and PLA (Table 3) at Pre and 24 h Post-BAFT.

Table 3. Perceptual measurements: perceived recovery status (PRS) and delayed onset muscle soreness (DOMS).

	PRS		DOMS	
	Pre	**24 h Post**	**Pre**	**24 h Post**
CP	7.1 ± 2.4	8.1 ± 1.8	0.7 ± 1.1	1.3 ± 1.7
PLA	7.9 ± 1.3	7.6 ± 1.0	1.2 ± 2.1	1.7 ± 1.9

Data are expressed as mean ± SD. CP (compressive pantyhose); PLA (placebo).

Table 4 presents the belief of the participants regarding the two different pantyhose before the BAFT.

Table 4. Absolute and relative frequency of positive belief about the effects of each pantyhose.

Do you believe wearing these pantyhose...	CP	PLA
will improve your performance during the BAFT today?	7 (78%)	9 (100%)
will improve your recovery for the SHRT tomorrow?	8 (89%)	7 (78%)

BAFT (Ballet-specific aerobic fitness test); CP (compressive pantyhose); PLA (placebo); Standing heel-rise test performance (SHRT); n = 9; data presented as absolute (relative - %) frequency of positive answers.

Discussion

To our knowledge, this is the first study to assess the impact of wearing CP during a ballet-specific test on performance, physiological and perceptual indicators, as well as recovery indicators up to 24 h Post-BAFT, in amateur classical ballet dancers. Our main finding reveals that while there was no significant change in performance levels (SHRT - triceps *surae* muscle fatigability) from Pre-BAFT in the CP condition, indicating maintained performance, the PLA condition exhibited a significant decrease in the number of repetitions during the SHRT at 30 min Post-BAFT. This suggests that CP may have helped mitigate acute neuromuscular fatigue Post-BAFT in this essential muscle group. Such effects have practical implications for recovery, particularly in domains such as ballet dancing, where multiple performances may be required in a single day. We applied the SHRT to assess the fatigability of the triceps *surae* muscle group, given its critical role in ballet movements such as jumps, *relevés*, and *pointe*.[1,2] All other variables showed no differences between the CP and PLA conditions during both the BAFT or post-testing up to 24 h.

The current data suggest that using CP has no impact on performance during the BAFT. Our results do not align with other studies that reported performance improvements with compressive garments.[25,26] Driller and Halson, observed the effect of compressive garments in twelve highly trained cyclists and reported an increase of ≈ 1% on mean power output during 30 min of cycling, as well lower mean HR responses.[26] The authors suggested that the lower mean HR might indicate enhanced blood flow or redistribution, potentially associated with performance improvements. Similarly, Broatch et al.[25] reported that the use of compressive garments improved the performance of 20 recreationally active participants in repetitive-sprint cycling (4 sets of 10 × 6 s maximal sprints). They also observed lower HR responses and increased muscle blood flow during the sprints.[25] However, both studies differ from the present study regarding intensity, type of exercise, and performance measurements. Moreover, due to our innovative and promising method for overcoming placebo issues (i.e., visually unconventional placebo-control pantyhose that 'would provide a warming effect'), the current results about belief (Table 4) show we had a robust control over the potential placebo effect. It's worth emphasizing the significance of this type of control, namely placebo control, in studies examining ergogenic effects of compression pantyhose.[7,10]

The effects of compressive garments on neuromuscular fatigue and performance have yielded varied results in the literature.[22,27] One study reported no difference in peak concentric force of knee extensors and flexors up to 24 h Post a sprint and plyometric protocol in eleven participants with and without lower-body compression garments.[27] However, Pavin et al.[22] demonstrated that wearing compressive garments (20 – 30 mmHg) resulted in a small decrease in agility test and SHRT performance following a female soccer match compared to the control group.[22] These differences may be related to the type of exercise performed and the possible physiological mechanisms involved with compressive garments, such as lower HR values during exercise,[28] reduced lower limb volume,[29] improved muscle oxygenation and blood flow.[7,30] Nevertheless, overall, the underlying reasons for the potential attenuation of neuromuscular fatigue with CP require further investigation.

In the current study, recovery indicators assessed at 24 h Post-BAFT (including performance in SHRT, DOMS and PRS) did not show significant differences between CP and PLA conditions. These results suggest that CP did not confer superior recovery at 24 h Post-BAFT compared to PLA, despite reported benefits in some studies. For instance, moderately trained rugby players demonstrated lower DOMS 24 h after their exercise protocol (comprising sprints and plyometric bounds) when wearing compression garments with pressure ranging from 10-30 mmHg.[27] Similarly, wearing compression stockings (12-21 mmHg) has been found to reduce DOMS in recreationally active men after a 10 km road run.[31] Compression garments (20–30 mmHg) also attenuate DOMS in soccer players after the second match of a two-match series with a 72 h recovery period, potentially enhancing their ability to engage in high-intensity running during the subsequent match.[32] Differences between our findings and those of previous studies could be attributed to several factors, including variations in the duration and timing of CP usage (e.g., during exercise only or during both exercise and post-exercise protocols), as well as differences in the pressure applied. Additionally, discrepancies may arise from variations in the type, intensity, and duration of exercises performed across studies.[21,33] However, because some studies lacked adequate control measures or only implemented partial controls, we cannot entirely dismiss the potential influence of a placebo effect in those studies.[7,10]

This pilot study confirmed the feasibility of our research procedures, validating the approach and suggesting necessary adjustments for a larger subsequent main study. Methodological precautions, including consistent participant experience levels, familiarization, a seven-day interval between interventions, and an innovative placebo control that promoted equal belief and conditions between protocols, enhanced the study's robustness. The use of deception in this study was a deliberate strategy to ensure the effectiveness of the placebo control, overcoming a common challenge in research involving compression garments. Participants were fully informed after the completion of the study about the true nature and purpose of the research, including the use of placebo conditions. This approach was necessary to reduce bias and maintain the integrity of the results. The values of RPE and HR in the current study indicate that the relative intensity during phase 5 of the BAFT was near maximum (e.g., RPE ≈ 9.7 AU and HRmean ≈ 99%) in both CP and PLA conditions, which supports the validity of our experimental design. Additionally, the RPE of the sessions (i.e., 30 min Post-BAFT) did not differ between CP and PLA (≈ 9.1 AU), suggesting that the dancers perceived the sessions as 'very hard/intense' regardless of condition.

Future research could use a similar approach to assess compressive garments. For example, insights gained from this pilot may prompt the inclusion of more frequent and longer time-points for assessing recovery indicators, such as 48 h and 72 h intervals, rather than solely relying on the 24 h mark. Furthermore, extending the duration of ballet performances and incorporating multiple days of ballet activity beyond a single BAFT test could potentially lead to more pronounced acute fatigue and muscle damage in the dancers. Such adjustments are crucial for effectively testing the efficacy of CP. These findings inform essential modifications for the forthcoming main study.

This study has limitations, such as the lack of additional time points, direct measurements of internal pressure in the pantyhoses, and assessments of lower limb volume, muscle oxygenation, blood flow, and muscle function tests. The small sample size may have reduced the analysis power and increased the risk of a type 2 error. Additionally, while perceptual measures of DOMS are valuable, they may not fully reflect the physiological changes associated with muscle soreness. Thus, cautious interpretation of the results is warranted. As a pilot study, it provides insights that can guide future research with larger sample sizes.

We conclude that wearing 20-30 mmHg CP during a ballet test mitigates acute fatigue in the triceps *surae* muscle of amateur ballet dancers, which may be relevant for acute recovery. However, wearing CP has no influence in physiological and perceptual indicators (i.e., mean HR, peak HR, RPE) during the ballet test, or on recovery measurements (i.e., standing heel-rise test, DOMS, and PRS) up to 24 hours post-test. While compressive garments offer practical advantages and lack contraindications, it is crucial to conduct additional research to examine their effects in diverse performance and recovery contexts, as well as among different populations.

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