

Effectiveness of the contrast technique as recovery after effort according to professional athletes

Eficácia da técnica de contraste como recuperação pós-esforço segundo atletas profissionais

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Abstract

Introduction: Alterations caused in the metabolism of those who practice physical exercise regularly generate health benefits, however, in athletes, these alterations can cause muscle damage, so post-recovery recovery methods are extremely important for their physiological maintenance. **Objective:** To analyze the effectiveness of the contrast therapy technique with post-exercise recovery according to professional athletes. **Methods:** A questionnaire was applied that addressed the technical scientific knowledge of professional athletes over 18 years of age, of both sexes, about post-exercise effort recovery techniques (PERT), personal information, and ethical issues, on an online platform. Descriptive statistical analysis was performed, with values presented in percentages and an association through the Chi-Square test on the knowledge of PERT and other independent variables. **Results:** In total, 63 athletes, 15 women and 48 men, answered the online questionnaire, 71.4% were between 18 and 30 years old, including swimmers, footballers, and athletics practitioners, and 85.7% had more than three years' experience in the sport and 57.1% competed at an international level. Considering the main PERTs, 92.1% were aware, 58.7% knew more than four, 96.8% frequently used at least one PERT, and 65.1% had used it for more than three years. Knowledge of PERTs is associated with age ($p = 0.001$), education ($p = 0.001$), practice time ($p = 0.001$), hours of daily training ($p = 0.001$), and competitive level ($p = 0.03$). With respect to the use of the contrast technique, 36.5% of the respondents had already used it, and 34.9% found it effective. **Conclusion:** The athletes who used the contrast technique reported a good perception of recovery.

Keywords: Athletes. Muscle fatigue. Physical exertion. Recovery of function.

Resumo

Introdução: Alterações causadas no metabolismo de quem pratica exercício físico constantemente geram benefícios à saúde. Em atletas, porém, causam danos musculares e por isso métodos de recuperação pós-esforço são de extrema importância para a manutenção fisiológica de atletas. **Objetivo:** Analisar a eficácia da técnica de contraste com recuperação pós-esforço segundo atletas profissionais. **Métodos:** Aplicou-se um questionário online que abordou o conhecimento técnico científico de atletas profissionais acima de 18 anos, de ambos os sexos, sobre técnicas de recuperação pós-esforço (TRPE), informações pessoais e questões éticas. Realizou-se análise estatística descritiva, onde os valores foram apresentados em percentuais, e associação através do teste qui-quadrado sobre o conhecimento das TRPE e demais variáveis independentes. **Resultados:** Responderam ao questionário online 63 atletas, 15 mulheres e 48 homens, sendo que 71,4% tinham entre 18 e 30 anos de idade. Estes eram nadadores, futebolistas e praticantes de atletismo; 85,7% possuíam experiência superior a três anos na modalidade e 57,1% competiam em nível internacional. Sobre as principais TRPE, 92,1% tinham conhecimento, 58,7% conheciam mais de quatro, 96,8% usavam com frequência ao menos uma TRPE e 65,1% utilizavam a mais de três anos. O conhecimento de TRPE está associado à idade ($p = 0,001$), escolaridade ($p = 0,001$), tempo de prática ($p = 0,001$), horas de treino diário ($0,001$) e nível competitivo ($p = 0,03$). Quanto ao uso da técnica de contraste, 36,5% dos respondentes já a haviam utilizado e, destes, 34,9% a consideram efetiva. **Conclusão:** Os atletas que utilizaram a técnica de contraste relataram boa percepção de recuperação.

Palavras-chave: Atletas. Fadiga muscular. Esforço físico. Recuperação de função fisiológica.

Introduction

Performing physical exercise regularly causes the body to present alterations in its metabolism, resulting in benefits to quality of life. In athletes, laboratory data outside the expected standards directly affect physical performance, causing muscle damage and providing oxidative disturbances.¹ Some enzymes serve as physical performance markers, such as muscle creatine kinase (CKMM), which is directly associated with physical performance: when found in large amounts in the

bloodstream, it demonstrates a loss of muscle integrity, with a negative effect on the athlete's performance, which increases the chances of injury.²⁻⁴

During competitions, whether consecutive or not, energy expenditure becomes greater related to consumption, this being an inversely proportional and negative variable for the athlete's physiological aspect. To combat this situation, it is important to intake nutrients, to meet the necessary demand, which will reflect in greater accumulation of glycogen in the muscle, delay in muscle fatigue, extension of training, better performance, and muscle restoration after exercise.⁵

There are several techniques used to keep athletes active. Post-exercise recovery methods are extremely important, as they consist of repairing the effects caused by acute dysfunctions linked to continuous exercise, focusing on regularizing the homeostatic repair time and enhancing the athlete's performance so that they can continue their exercise program effectively.⁶ Recovery methods also prevent injuries resulting from exertion, which is closely linked to the importance given to the processes that adapt the athlete's physiological maintenance, allowing positive evolution of their performance.⁷

Studies have been developed to evaluate recovery techniques, showing that the contrast technique, which means alternately exposing the athlete to heat and cold, promotes an increase in metabolism and, in daily sports, removes some negative biomarkers that interfere with post-exercise recovery.^{7,8} Several studies have characterized the method as a good remover of cellular waste, which is found in efforts that characterize the increase in intensity, as well as being able to relax skeletal muscles and improve individual perception.⁷ The alternation of temperature causes vasodilation and vasoconstriction, important mechanisms to decrease pain perception, minimize post-exercise edema, interfere with inflammatory pathways, and decrease feelings of fatigue.⁷⁻¹⁰

Given the diverse variations presented by the contrast technique, there is no specific research on the effectiveness of its applicability as a modulator of the inflammatory process and recovery of cell membrane damage.¹¹ Thus, the current study seeks more information about this process, in order to fill the gaps surrounding the subject and complement previous analyses. The aim of the study was to analyze the subjective effect of contrast therapy in professional athletes after exertion, using an online questionnaire.

Methods

This is a convenience analysis, using a descriptive form to demonstrate the knowledge of professional athletes about post-exercise recovery techniques and their effectiveness.

The project was approved by the Research Ethics Committee (CAAE: 34748720.3.0000.5515) of the Universidade do Oeste Paulista (UNOESTE). All volunteers who participated in the study signed a Free and Informed Consent Term (ICF) provided virtually together with the questionnaire, evidencing that they agreed to participate in the study.

The study was carried out through a questionnaire made available in Portuguese, English, and Spanish on the Google® online platform, called Google Forms. The questionnaire was disseminated by social media, email, and also by acquaintances who participate in sports confederations. The questionnaire was developed by the researchers, so it was original, and was answered by professional athletes regardless of their associated institution, municipality, state, and country, between September and November 2020. A minimum number of 50 athletes was stipulated, aged over 18 years, of both sexes, and who were active at the time of answering the questionnaire. Athletes who did not reach the minimum age were excluded.

The questionnaire was divided into four sections:

S1 - Cover page of the questionnaire, consisting of project presentation, ethical questions, ICF, and signature field agreeing to participate in the study.

S2 - Personal information: full name, sex, age, weight, height, city, state, country, level of education, sport in which the athlete is a professional, how long they have been a professional athlete, daily training time, level at which they compete, and the working team who act in the sport practiced.

S3 - Knowledge about post-exercise recovery techniques (PERT), with questions involving participants' knowledge of the main types of PERT, level of knowledge, which PERT methods they used the most, and how long they have used the method for.

S4 - In this section, the participants indicated whether they had already used contrast therapy, if they considered it an efficient technique, the duration of the technique, which temperature parameters they used, and the sensation experienced with contrast therapy, with responses ranging from "very effective" to "indifferent".

Descriptive analysis was used to demonstrate the athletes' knowledge of post-exercise recovery techniques and their effectiveness. The Kolmogorov-Smirnov normality test was performed. In the case of a Gaussian distribution, analysis of variance (repeated measures ANOVA) was used, followed by the post-hoc test to compare the types of athletes. In case of non-normal distribution, the Kruskal-Wallis test was used, followed by the post-hoc test. All procedures adopted a significance value of 5%. For categorical variables, the chi-square test was used and logistic regression was performed in order to obtain odds (probabilities). The calculations were performed with the statistical program SPSS 17.0 for Windows®.

Results

In total, 63 professional athletes responded to the online questionnaire; 15 women (24%) and 48 men (76%); 71.4% were between 18 and 30 years of age; 66.7% were from the state of São Paulo; 52.4% had completed higher education; and 15.9% were postgraduates. Regarding anthropometric data, 93% weighed between 65 and 85 kg and 41.2% measured more than 1.80 m in height, as shown in Table 1.

Table 1 - Characteristics of the sample (n = 63)

	Characteristics	n (%)
Sex	Male	48 (76.0)
	Female	15 (24.0)
Age (years)	18 - 20	9 (14.3)
	21 - 25	20 (31.7)
	26 - 30	16 (25.4)
	31 - 35	10 (15.9)
	> 35	8 (12.7)
Height (meters)	1,50 - 1,60	3 (4.8)
	1,61 - 1,70	12 (19.0)
	1,71 - 1,80	22 (34.9)
	> 1,80	26 (41.3)
Weight (kg)	65 - 75	35 (55.6)
	76 - 85	24 (38.1)
	86 - 95	3 (4.8)
	96 - 105	1 (1.6)

Regarding the modalities practiced, 38.1% were swimmers, 33.3% were soccer players, and 14.3% were athletics practitioners (Figure 1). In terms of time spent in the sport, 85.7% had more than three years of experience, 46% trained between two and four hours a day, 34.9% more than four hours a day, and 57.1% competed at an international level.

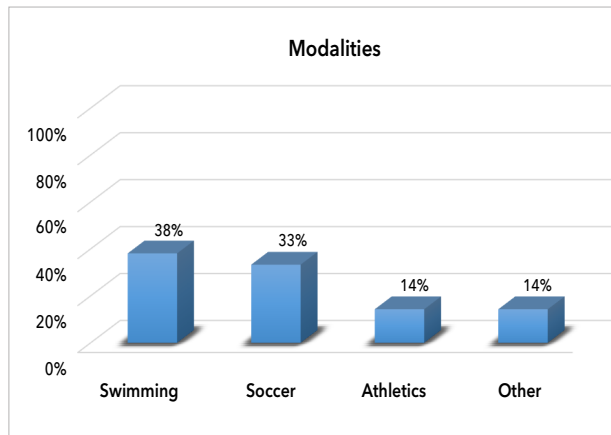


Figure 1 - Quantity in percentage of athletes in each modality.

In addition to the contrast technique, the athletes were asked about other types of recovery techniques, and 92.1% were aware of the main techniques currently used, 58.7% knew more than four PERTs, 63% reported having reasonable knowledge about PERTs, 96.8% frequently used at least one PERT, and 65.1% had used it for more than three years. It was found that knowledge about PERTs is associated with age ($p = 0.001$), education ($p = 0.001$), time of practice ($p = 0.001$), hours of daily training (0.001), and competitive level ($p = 0.03$).

Of the 36.5% respondents who had already used the contrast technique, 34.9% considered it effective. Considering the application time, 25.4% applied it for up to two minutes of immersion in hot water and up to 1 minute in cold water (Figure 2) and 11.1% remained for more than two minutes in hot water and more than 1 minute in cold water. Finally, 31.8% felt good recovery from the application of contrast therapy (Figure 3). The negative correlation $r = -0.48$ and $p = 0.02$ showed that the shorter the application time (≤ 2 min), the greater the sensation of effectiveness of the technique. Temperature, on the other hand, had no correlation with the perception of effectiveness of the technique ($p = 0.16$).

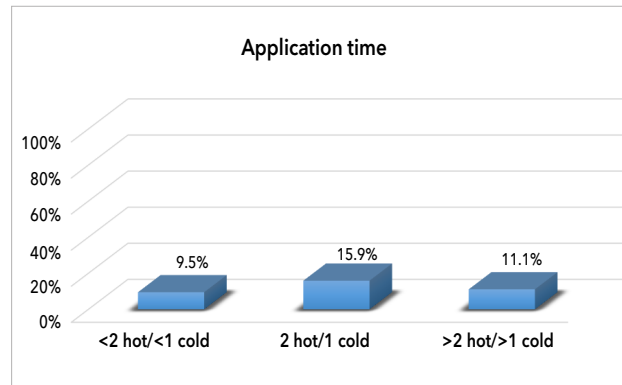


Figure 2 - Application time (minutes) in percentage.

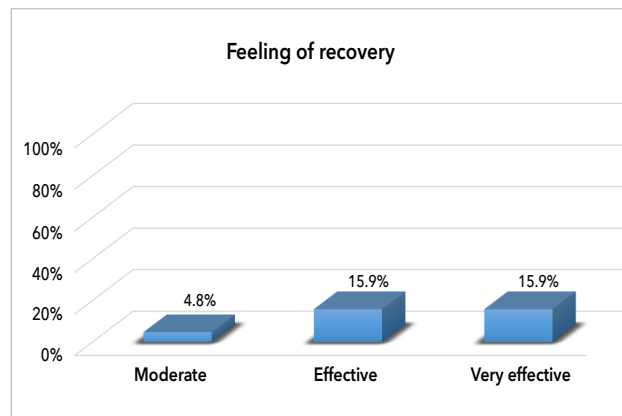


Figure 3 - Subjective perception of post-exercise recovery.

Discussion

The current study presents the results of a quantitative analysis of the percentage of knowledge of professional athletes in relation to contrast therapy for post-exercise recovery, analyzing its effectiveness and applicability. In relation to the respondent public, there was a prevalence of the male sex, an expected result, since there are still barriers regarding the social acceptance of women as sports professionals despite the great changes in relation to female inclusion in sports. According to Franco,¹² there is a large influence of physical education in Brazilian schools to demystify that only men can be in the sports environment, thus enhancing the presence of women in the various sports modalities. Pfister¹³ contrasts socioeconomic issues by showing that adolescent girls belonging to the middle or upper classes are more involved in the sports world than lower class girls, and

Gentile et al.¹⁴ discuss the threat of gender stereotypes on female performance in sports activities, showing that this is stronger among male than female sports.

Regarding the anthropometric data of the athletes, the body mass index (BMI) values were in the range of 22 and 23, characterized as normal. Bonatto et al.¹⁵ emphasize that BMI cannot be used as an absolute truth, since there are individuals who have a large amount of muscle mass, which can classify them as overweight. Therefore, it is important to consider the data set presented on body constitution and BMI.

With respect to education, 52.4% of those who responded had completed higher education and 15.9% had a graduate degree. Although this result is relevant, it could have been even more so, since in Brazil there is still a parallel between a training institution and college/university. Haas et al.¹⁶ showed that the sports calendar is not the same as the academic calendar, thus providing a set of unfavorable factors such as physical fatigue resulting from training, displacement, financial issues, and replacement of absences on match days. Thus, there is an increase in the athlete's disinterest and consequent lack of motivation to continue higher education studies.

Among the results found on the knowledge of PERTs, 92.1% were aware of the main techniques currently used, however, it was observed that there is little knowledge about contrast therapy, data that are in agreement with those of Pastre et al.⁷ In the literature, there are still few specific studies that determine the most effective time and temperature in the elimination of cellular waste and in the modulation of the post-exercise muscle inflammatory process. The result of this is low adherence by coaches, physical educators, and physical therapists and, consequently, the athlete's lack of knowledge about this type of recovery. Theoretically, the physiological principles apply to the treatment, but they lose significance because there is no practical description of its applicability.

The definition of temperature and exposure times used in PERTs still lack studies that prove and accurately determine the effectiveness in eliminating harmful energy biomarkers. Pastre et al.⁷ and Paddon-Jones and Quigley¹⁷ used a protocol of exposure to cold temperatures (5 ± 1 °C) for 20 minutes, as opposed to Yamane et al.¹⁸ (10 ± 1 °C) who used the same time, and found no statistical significance when comparing the control and intervention groups. Caetano et al.,⁸ when analyzing the technique with immersion in 260-liter

plastic containers, used a cold temperature of 10 °C for one minute and a hot temperature of 42 °C for 2 minutes, and reported a decrease in the concentrations of the marker used in the study (lactate) 5, 15, and 25 minutes after application of therapy. There is still a need, therefore, for studies that provide evidence of and define a time and temperature protocol for the technique, since in the present study it was not possible to carry out practical procedures.

Post-exertion subjective perception is relevant in the recovery process, due to the decrease in pain perception and stimulation of analgesic effect,¹⁹ however, it is necessary to submit individuals to pre-defined protocols for an effective comparison between the methods.

Regarding the limitations of the present study, some extremely important points can be highlighted: the first is due to the atypical situation that we experienced in the year in which the study was carried out. COVID-19 and its isolation conditions and precautions meant the experimental design needed to be carried out through an online questionnaire, which may be a bias of the study, since the athlete could have researched the technique while answering. The second point is the importance of analyzing the morphophysiological parameters to analyze the effects of the technique, since subjective perception is relative from athlete to athlete. Thus, it is necessary to carry out new studies in order to complement this research, cross referencing the information from the subjective perception of these athletes with the blood parameters, in order to verify if the results are reliable.

According to the bibliographic survey carried out for the elaboration of the work, little is known about the contrast technique, and its true functionality and effectiveness in post-exercise recovery. This study demonstrates the need to deepen the elaboration of protocols for the applicability of the technique, in view of the lack of knowledge about the values of time and temperature (total and intervals) that leads to its lack of use. The cost-effectiveness of the therapy often ends up making the application unfeasible, hence the importance of studies aimed at technological development that can help in the creation of relevant products in the sports field. The completion of the survey by questionnaire was extremely important for the analysis of the athletes' knowledge about what they feel after the recovery technique, since in most situations only the theoretical reference is taken into account, without analyzing the

response of the athlete. The perception of the athlete is an important factor to enhance the response to therapy; as stated by Beedie et al.,¹⁹ the belief in the treatment is a preponderant item for its success.

Conclusion

It was observed that only a quarter of the athletes had already used the contrast technique. Among these, most felt a good recovery from the application, however, with a difference in the alternation times between hot and cold. Knowledge of PERTs was associated with age, education, time of practice, and hours of training.

The importance of practical studies is highlighted, to create protocols for the technique, of alternating temperature and time, as well as analysis of the morphophysiological parameters, in order to increase knowledge of the contrast technique in the sports environment, so it can be used as an effective method of post-exercise recovery.

Authors' contributions

Each author contributed significantly to the development of this article. PVTS and HPJ were responsible for designing the study. Data were collected by PVTS, JLPA, and PEMO and analyzed by HPJ and PEMO. The article was written by the authors PVTS, HPJ, RCC, JLPA, and EACZ, and the review was carried out by PVTS, RCC, JLPA, and PEMO. EACZ was responsible for the statistical analysis, intellectual conception of the article, and elaboration of the entire research project.

References

1. Chamera T, Spieszny M, Klocek T, Kostrzewa-Nowak D, Nowak R, Lachowicz M, et al. Post-effort changes in activity of traditional diagnostic enzymatic markers in football players' blood. *J Med Biochem.* 2015;34(2):179-90. [DOI](#)
2. Moura NR, Cury-Boaventura MF, Santos VC, Levada-Pires AC, Bortolon JR, Fiamoncini J, et al. Inflammatory response and neutrophil functions in players after a futsal match. *J Strength Cond Res.* 2012;26(9):2507-14. [DOI](#)
3. Malone S, Mendes B, Hughes B, Roe M, Devenney S, Collins K, et al. Decrements in neuromuscular performance and increases in creatine kinase impact training outputs in elite soccer players. *J Strength Cond Res.* 2018;32(5):1342-51. [DOI](#)
4. Aquino RLQT, Gonçalves LGC, Vieira LHP, Oliveira LP, Alves GF, Santiago PRP, et al. Periodization training focused on technical-tactical ability in young soccer players positively affects biochemical markers and game performance. *J Strength Cond Res.* 2016;30(10):2723-32. [DOI](#)
5. Briggs MA, Cockburn E, Rumbold PLS, Rae G, Stevenson EJ, Russell M. Assessment of energy intake and energy expenditure of male adolescent academy-level soccer players during a competitive week. *Nutrients.* 2015;7(10):8392-401. [DOI](#)
6. Bastos FN, Vanderlei LCM, Nakamura FY, Bertollo M, Godoy MF, Hoshi RA, et al. Effects of cold water immersion and active recovery on post-exercise heart rate variability. *Int J Sports Med.* 2012;33(11):873-9. [DOI](#)
7. Pastre CM, Bastos FN, Netto Jr J, Vanderlei LCM, Hoshi RA. Métodos de recuperação pós-exercício: uma revisão sistemática. *Rev Bras Med Esporte.* 2009;15(2):138-44. [DOI](#)
8. Caetano HRS, Lima GOM, Ozaki GAT, Pacagnelli FL, Castoldi RC, Zanuto EAC. Efeito da técnica de contraste sobre a concentração plasmática de lactato durante a recuperação pós-esforço. *Colloq Vitae.* 2017;9(3):24-30. [Full text link](#)
9. Dupuy O, Douzi W, Theurot D, Bosquet L, Dugué B. An evidence-based approach for choosing post-exercise recovery techniques to reduce markers of muscle damage, soreness, fatigue, and inflammation: A systematic review with meta-analysis. *Front Physiol.* 2018;9:403. [DOI](#)
10. De Nardi M, La Torre A, Barassi A, Ricci C, Banfi G. Effects of cold-water immersion and contrast-water therapy after training in young soccer players. *J Sports Med Phys Fitness.* 2011;51(4):609-15. [Full text link](#)
11. Beedie C, Whyte G, Lane AM, Cohen E, Raglin J, Hurst P, et al. 'Caution, this treatment is a placebo. It might work, but it might not': why emerging mechanistic evidence for placebo effects does not legitimise complementary and alternative medicines in sport. *Br J Sports Med.* 2018;52(13):817-8. [DOI](#)

12. Franco N. Gênero e esporte: masculinidades e feminilidades na escola. *Rev Estud Fem.* 2016;24(2):665-8. [DOI](#)
13. Pfister G. Sport and gender equality. *Girls in focus. City, Sport and Education - Volume 2 de Monograph - International Association of Educating Cities.* Barcelona, Espanha: IAEC; 2010. p. 31-9. [Full text link](#)
14. Gentile A, Boca S, Giammusso I. 'You play like a Woman!' Effects of gender stereotype threat on women's performance in physical and sport activities: A meta-analysis. *Psychol Sport Exerc.* 2018;39:95-103. [DOI](#)
15. Bonatto GFC, Correa VG, Massing E, Mateus TL, Koehnlein EA. Perfil antropométrico, consumo de macronutrientes e micronutrientes antioxidantes de atletas profissionais de futsal do oeste e sudoeste do Paraná. *R Bras Ci e Mov.* 2018;26(1):65-74. [DOI](#)
16. Haas CM, Carvalho RAT. Escolarização dos talentos esportivos: busca pelo sucesso no esporte, distanciamento da escola e conflitos legais. *Rev @mbienteeducação.* 2018;11(3):374-94. [Full text link](#)
17. Paddon-Jones DJ, Quigley BM. Effect of cryotherapy on muscle soreness and strength following eccentric exercise. *Int J Sports Med.* 1997;18(8):588-93. [DOI](#)
18. Yamane M, Ohnishi N, Matsumoto T. Does regular post-exercise cold application attenuate trained muscle adaptation? *Int J Sports Med.* 2015;36(8):647-53. [DOI](#)
19. Vaile J, Halson S, Gill N, Dawson B. Effect of hydrotherapy on the signs and symptoms of delayed onset muscle soreness. *Eur J Appl Physiol.* 2008;102(4):447-55. [DOI](#)