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Acute effects of different intervals between repeated sprints on performance responses in amateur futsal athletes

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Abstract

Background:

Interventions with the performance of sessions with sprints in different intensity manipulations, can be a great alternative to improve physical performance.

Objective:

To verify the influence of different break times between sprints on the performance of amateur futsal athletes

Methods:

10 individuals, men, amateur futsal athletes (Age: 21.5 ± 1.6; Weight: 72.4 ± 6.88; Height: 1.72 ± 0.05; BMI: 24.3 ± 1.2; Fat%: 13.7 ± 3.3, VO_{2peak}: 49.1 ± 10.5) participated

in the study. For the intervention, individuals were randomly selected to perform sessions with sprints (10 sets 20 meters) with different pause times, being 15 (S_{15}), 30 (S_{30}) and 60 (S_{60}) seconds. For performance analysis, the speed (km / h) applied to each sprint was used, monitored by a device with a photocell (CEFISE Biotecnologia Esportiva®, Nova Odessa, São Paulo) and the statistical treatment of all data was through the software Statistica 7.0 (Statsoft ™, Tulsa, OK, USA) using a significance level of $p \leq 0.05$.

Results:

There was an interaction between speed and interval time ($p = 0.000$). For condition S15, a greater reduction in performance was observed ($p \leq 0.05$), while for S_{30} and S_{60}, no significant reduction in performance was observed ($p > 0.05$). The data for the area under the curve showed a significant difference ($p = 0.000$), where the interval of 60 seconds (S_{60}) was longer compared to the values of 30 (S_{30}) ($p = 0.000$) and 15 seconds (S_{15}) ($p = 0.000$). However, there were no significant differences between the 30 and 15 second data ($p = 0.248$).

Conclusion:

Shorter time (15 seconds) of interval between repeated sprints can significantly affect performance when compared to longer breaks (30 and 60 seconds). But, all the conditions tested here, can be positive for the improvement of the performance, mainly in sports that demand fast and efficient motor actions, as for example, futsal.

Keywords:

Repeated Sprint Training, Speed Performance, Physiology, Sports

1. INTRODUCTION

Interval training (IT) is an excellent method among the different methods of exercise prescription aiming at improving performance, since it can be used for both anaerobic [1] and aerobic stimuli [2]. IT can present variations in stimuli, intensities and recovery, and within this context, one of the variations widely used in different sports are high intensity stimuli [3]. Traditionally, the application of IT in sprint format has been well accepted with the aim at improving performance [4] and even for health promotion [5].

The training sessions of sprints format are characterized by two types, sprint interval training (SIT) and repeated sprint training [6]. SIT is generally used with stimuli of approximately 30 seconds with passive or active recovery of 2 to 4 minutes [7]. RST is applied with short stimuli (~ 3 to 7 s duration) and with passive recovery of up to 60 seconds [8] . For sprint interventions (SIT or RST), the stimuli are at maximum or supra-maximum levels of physiological [9] or perceptual parameters [10]. However, both sprint variations are efficient for different purposes [11,12]. In sports, sprint interventions have been used for several modalities [6], which consequently seems to be a great strategy to achieve results, optimize training time and, thus, preserve the individual through long wear arising from long training time [5].

The sprints (SIT and RST), belong to the IT method applied with high intensity, popularly called as high intensity interval training (HIIT) and, its use has some physiological aspects that are extremely important to improve physical performance [3]. Studies demonstrate that high intensity stimuli using the interval method can improve maximum oxygen consumption [13] and also, muscle adaptations for better use of the oxygen captured and offered to the tissue [14]. Additionally, interventions with high intensity stimuli (i.e., RST) are capable to promote improvement in mitochondrial density and biogenesis [15,16], in addition to improvements in glycolytic metabolic behavior and oxidative [17], as well as cardiovascular functions [18], these mechanisms being important for the promotion of greater performance.

With regard to sprint intervention, some gaps still need to be explored, for example, the time interval between sprints performed for maintenance or less reduction in performance. In fact, the shorter the interval, the lower the energy restoration, and the greater the loss of performance [19]. However, the correct conduction of the training, especially considering the high intensity ones, can improve the metabolic integration capacity [1,2] and with this, even with shorter intervals, there can be a minimization in the drastic reduction of performance. Thus, the objective of the present study was to verify different intervals between sprints and observe the magnitude of different pause times in sprint speed in amateur futsal athletes.

2. METHODS

2.1. Participants

Ten male amateur futsal athletes of the Catholic University of Petrópolis, Rio de Janeiro, Brazil participated of this study (table 1). To be included in this study, participants should be free of ostemioarticular lesions, with no history of cardiovascular diseases and would be willing to participate, without any type of interruption. On the other hand, the exclusion criteria were the use of ergogenic resources, muscle pain (even if no injury was diagnosed) and lack of availability for the present study. After the selection of participants, all were recommended to do not use excessive consumption of salt, caffeine, alcohol, in order to avoid interference in cardiovascular responses. All individuals did not undergo training for a week, only performed the interventions in this study. After explaining the risks and benefits of the research, the participants completed the Physical Activity Readiness Questionnaire (PAR-Q) and signed a free and informed consent form, according to 466/2012 of the National Health Council and also the Helsinki resolution.

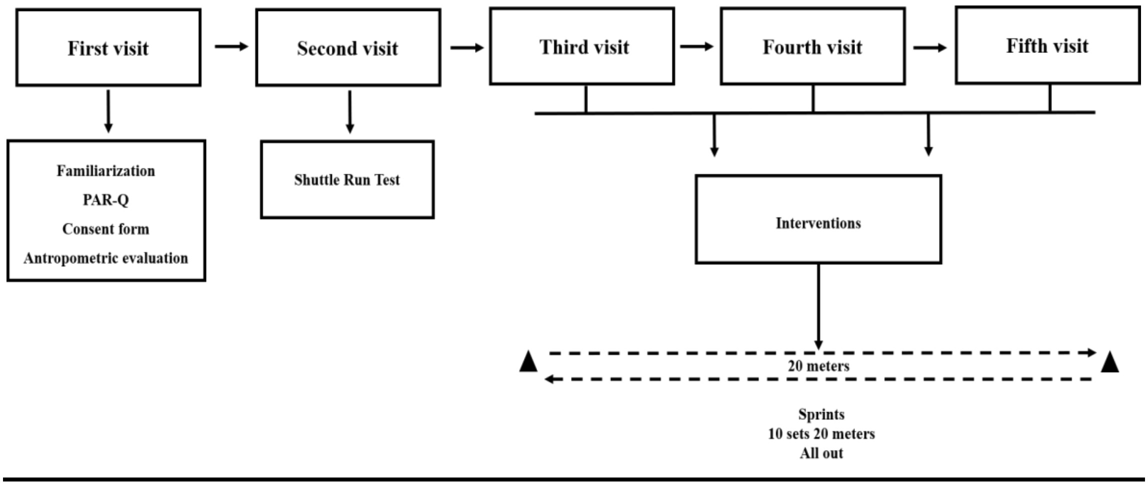
Table 1. Anthropometric characteristics of the participants

Variables	Participants
	M±DP
Age (years)	21.5± 1.6
Weight (kg)	72.4 ± 6.88
Height (m)	1.72 ± 0.05
BMI (kg/m^2)	24.3± 1.2
Fat (%)	13.7 ± 3.3
VO_{2Peak} (ml.kg^{-1}.min^{-1})	49.1± 10.5

2.2. Experimental design

The study was divided into five visits (Figure 1). In the first visit, the participants were familiarized with all the research procedures and, in the same visit, the participants completed the Physical Activity Readiness Questionnaire (PAR-Q), received the free and Informed Consent Form (ICF) to firm and also performed a physical assessment to collect anthropometric data. On the second visit, the Shuttle Run Test for aerobic capacity/power was performed [20], for conditional characterization of the sample and also to direct the level of intensity that would be applied in the experiments. The last three visits were designated for the experimental intervention and the individuals performed sprint sessions (10 x 20m) and for each session, different interval times were drawn to be used between the sprints, being 15 (S_{15}), 30 (S_{30}) and 60 (S_{60}) seconds apart. All visits occurred with interval of 48 hours.

Figure 1. Flowchart of the experimental procedure**.**



2.3. Training protocols

In view of the methodological aspects, the intervention of the present study consisted of sessions with repeated sprint training (RST). Each participant was randomly selected to order the experimental visits (S_{15}, $S_{30}$and S_{60}). Between each visit for the tests, the minimum interval of 48 hours should be respected. The experiments were carried out in a sports court. Before the performance of the 10 sprints, a 5-minute warm-up was performed, consisting of: 1) 2 laps on the court at a moderate pace (40-60% HR_{Max}); 2) joint heating (3 minutes); 3) short runs, lateral displacements and backward displacement, in the form of a circuit (3 series) with moderate to high intensity (40-80% HR_{Max}). After the warm-up phase, the participants prepared the start of the sprints, with 10 series of 20 meters at all out intensity. At the beginning of each test, athletes received standard information, citing: 1) where to position themselves at the beginning of each sprint; 2) start time; 3) place and time of braking; 4) how many repetitions would be done; 5) what is the interval between sprints. For each sprint in each experiment, a 5-second countdown (5,4,3,2,1) was conducted by one of the researchers, followed by a beep (short hiss) that corresponded to the start of a new sprint.

2.4. Performance analyzes

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For performance analysis it was performed through the speed (km/h) applied during the course of each sprint for all conditions (S_{15}, S_{30} and S_{60}). The speed measurement in the sprints performed was performed with the use of a photocell apparatus (CEFISE Biotecnologia Esportiva®, Nova Odessa, São Paulo). For comparative effect, an intra condition analysis was performed for all sprints and, inter conditions between them. sprints for each condition.

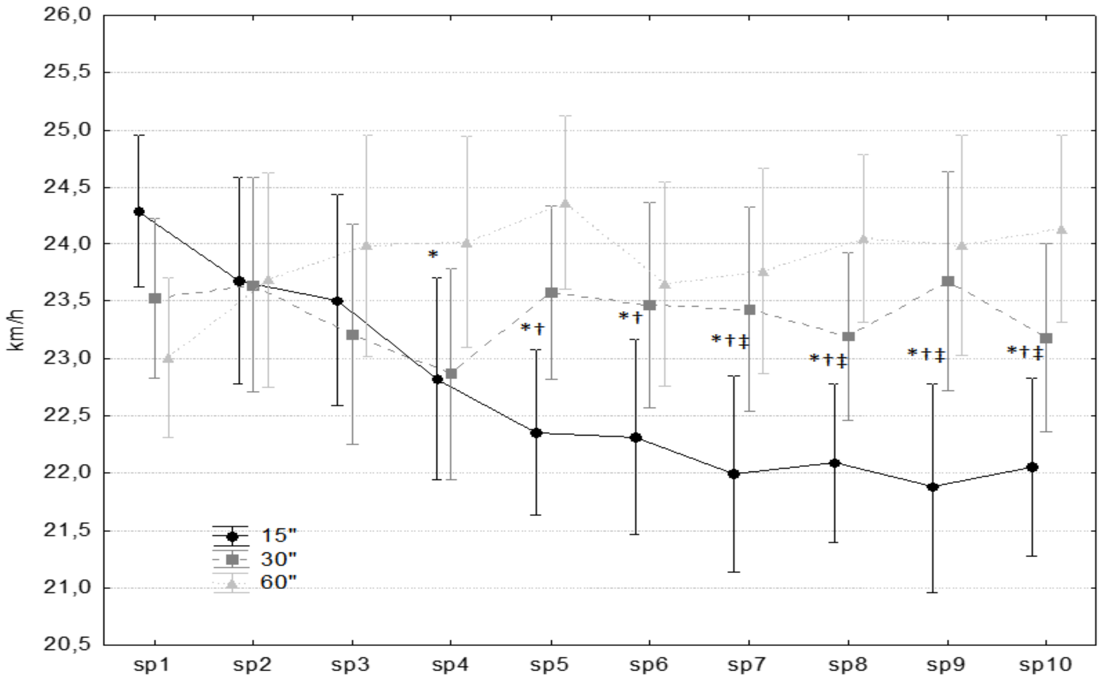
2.5. Statistical analyzes

All results were presented as mean ± standard deviation (SD). A two-way ANOVA was applied for repeated measures to test possible differences between sprints (km/h), under different interval conditions (S_{15} vs S_{30} vs S_{60}). The area under the curve (ASC) was also calculated using the trapezoidal method and compared between the different interval conditions between the sprints using a one-way ANOVA. Fisher's post-hoc test (LSD) was performed with the objective of multiple comparisons. In all cases, the level of significance was set at $p \leq 0.05$, and the calculations were made using the Statistica 7.0 software (Statsoft ™, Tulsa, OK, USA). For the sample size calculation, the GPower 3.1 software.

3. RESULTS

The two-way ANOVA analysis showed a significant difference for the interaction between speed (in km/h) x interval conditions ($p = 0.000$). In condition S_{15} (Figure 2), reductions were observed in the performance ($p \leq 0.05$) of the sprints from the fourth sprint (SP4) in relation to the speed of the initial sprint (SP1); from the fifth sprint (SP5) in relation to the speed of the second sprint (SP2); from the seventh sprint (SP7) in relation to the speed of the third sprint (SP3). Additionally, no significant differences were observed between the different interval conditions ($p = 0.067$).

Figure 2. Performance analyses in the sprints, for all conditions.



* Significant difference in relation to the initial sprint (SP1); † Significant difference in relation to the second sprint (SP2); ‡ Significant difference in relation to the third sprint (SP3).

Additionally, the data for ASC (Figure 3) showed a significant difference ($p = 0.000$), where the interval of 60 seconds (S_{60}) was longer compared to the values of 30 (S_{30}) ($p = 0.000$) and 15 seconds (S_{15}) ($p = 0.000$). However, there were no significant differences between the 30 and 15 second data ($p = 0.248$).

Figure 3. Analysis of the área under the curve, for all conditions

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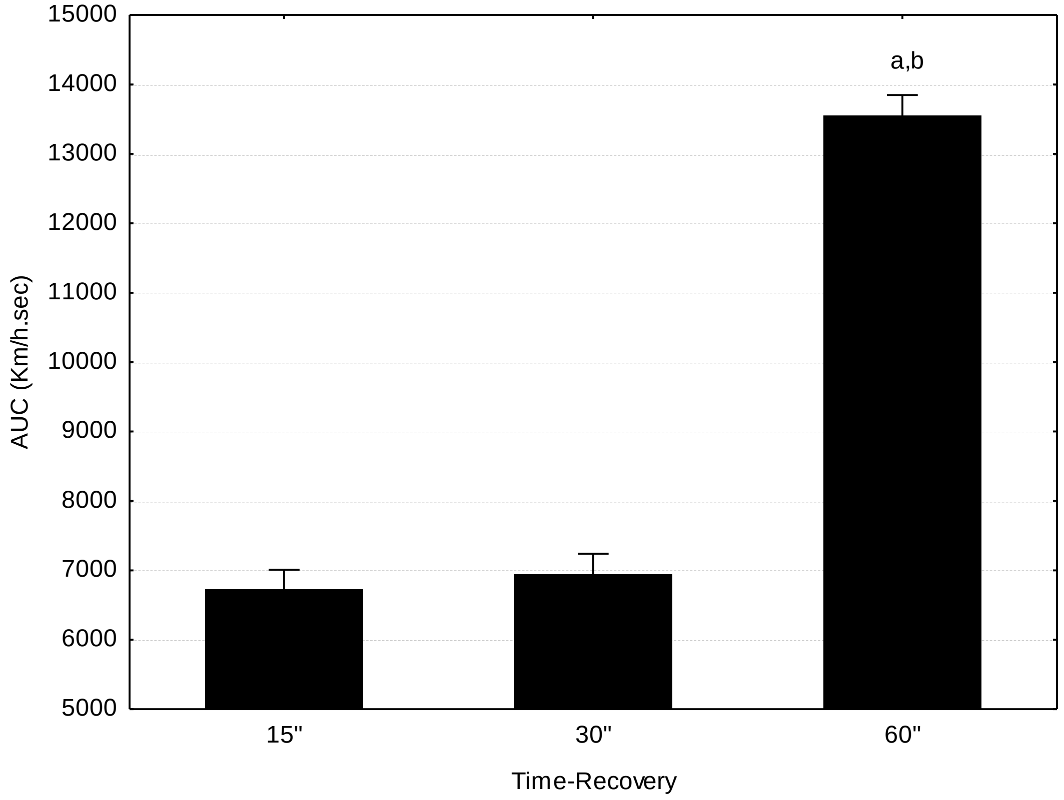

[a] Significant difference in relation to ASC from the 15-second interval condition.

[b]Significant difference in relation to ASC from the 30-second interval condition.

4. DISCUSSION

The aim of the present study was to verify the influences of different intervals (15, 30 and 60 seconds) on performance between repeated sprints (RST) in amateur futsal athletes. A greater reduction ($p \leq 0.05$) of performance was observed in the shortest break time (15 seconds - S_{15}) when compared to the other interval conditions (30 seconds - S_{30} and 60 seconds - S_{60}). Through the analysis using the area under the curve (ASV), it was observed that 60 seconds (S_{60}) of pause can be a great option for the maintenance of the performance, specifically in short sprints (20m) with maximum speed or supramaximal (all out).

This research was directed to performance analysis through speed applied in the subsequent sprints (10 sets x 20 meters). Studies have compared performance through applied power [20,21] and time [22]. With speed, the studies are discreet and inconclusive, but considering that this variable (speed) is extremely important for performance evaluation, especially when it comes to futsal athletes, even here, that the participants were amateurs. Balson et al. [23], observed in three different series and stimulus protocols (40x15m, 20x30m and 15x40m), but with equal pause intervals (30s), that the protocols with less series, but with greater distance for the sprint (30 and 40 meters) were those that showed the greatest reduction in performance. In the present study, the protocol with the shortest interval (S_{15}) showed a significant reduction in performance. With these findings, we can suggest that the tension time deserves attention at the time of prescription, since this variable can be manipulated by the stimulus time and, consequently, by the shorter recovery time which, in sum, would influence the energy reserves.

Gaitanos et al. [20], observed a significant reduction in the last sprints (10 x 6s) with 30-second intervals, which, even analyzing different variables, does not corroborate the findings of this study, where for the 30-second interval (S_{30}), no significant differences were identified. However, the present research evaluated running sprints and the mentioned study carried out their interventions on a cycle ergometer. Therefore, we cannot extrapolate these results to generalize the repercussions of 30-second breaks. Similarly, Glaister [22], found different intervals (10 and 30 seconds) between sprints of 5 seconds (20 sets) and, they observed that with 10 seconds the performance reduction in the average applied power was greater. So, in fact, a shorter interval generates a greater loss of performance, whether in power, in the time of realization and demonstrated here through speed. Therefore, studies that verified inter sprints performance are scarce, which creates a restriction of deductions on this type of intervention, especially when there are different types of recovery intervals.

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On the other hand, interventions using sprints can also be great strategies for improving autonomic function [24,25], cardiac function through better chemical reactions [21] and structural [22] in addition to cardiopulmonary improvements [4]. Studies have found that sprint interventions can also be a great option for improving the performance evaluated through mountain bike race simulation [9] and several other tests such as squat jump, countermovement jump, sprinting speed (5,10 , 20 and 30m), change of direction and speed tests [23].

However, the mechanisms involved in maintaining performance between sprints with different intervals and this type of intervention to improve physical performance are still inconclusive. However, studies direct us to physiological parameters that are directly linked to performance, such as the improvement of the cardiovascular system through better activation and autonomic balance (sympathetic vs. parasympathetic) [24] and, with sprints all out there is an increase in blood flow and, consequently, an increase in the levels of nitric oxide in the endothelial structures, balancing blood pressure and generating better vascularization [18], due to greater vasodilation and arterial compliance [25].

Regarding intramuscular behavior, sprint intervention increases the capacity for musculoskeletal adaptation more quickly [14], promoting a more efficient response during stimuli, especially those of high intensity. With regard to metabolic behavior, high-intensity training increases glycolytic and oxidative capacity [17,18] which can be an important factor in promoting metabolic integration [26] and thus, minimizing the levels of fatigue that impair performance. Finally, sprints can also generate improvements in the intramuscular component, promoting greater density and even mitochondrial biogenesis, which is an important adaptation for performance [15,16]. These mechanisms are said to be improved through sprint interventions (SIT and RST), but are extremely important for determining maintenance and reducing performance between a sprint training session, according to the present study.

The present study has some limitations, one of which is the sample size. Another limitation was the fact that we did not measure lactate levels before and after interventions. This way, we would have a greater visualization about the metabolic behavior before different intervals for the same stimulus distance (20m). Finally, this study applied acute analysis, which limits only the range assessment. With a chronic analysis, before a load control, it is possible to find a smaller reduction in performance, even with shorter break time, due to the conditional gains resulting from the sessions with sprints. However, it is suggested to elaborate new studies for the same theme, having other variables (mechanical and physiological) as analyzes, so that we can have more information about the influence of the interval in the performance.

CONCLUSION

In view of the findings, we can conclude that a shorter time (15 seconds) of pause between repeated sprints can affect performance more significantly when compared to longer pauses (30 and 60 seconds). But, for practical applicability, prescriptions with shorter recovery times may be feasible when there is an interest in manipulating a higher intensity through the use of a denser training. While, sprint sessions with longer pauses can be applied when there is an intention to do an intense workout in a block (week) where all training is being conducted at high intensities, in this way, the individual's preservation will be greater. However, all the conditions tested here can be positive for improving performance, especially in sports that require fast and efficient motor performances, such as futsal.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study complied with Resolution 466/12 of the National Health Council (CNS) and was approved by the local Research and Ethics Committee, code CAAE: 800 63917.4.0000.5281.

HUMAN AND ANIMAL RIGHTS

No animals were used for this study. All humans research procedures performed in the current study were following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

CONSENT FOR PUBLICATION

All participants were informed about the protocol and gave their written informed consent before participating in the study.

AVAILABILITY OF DATA AND MATERIALS

The datasets analyzed during the current study available from the corresponding author [Sant'Ana LO] on the immediate request.

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None

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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