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Original Article

ACUTE EFFECTS OF DIFFERENT INTERVALS BETWEEN REPEATED SPRINTS ON PERFORMANCE RESPONSES IN AMATEUR FUTSAL ATHLETES

EFEITOS AGUDOS DE DIFERENTES INTERVALOS ENTRE SPRINT REPETIDOS SOBRE AS RESPOSTAS DE DESEMPENHO EM ATLETAS AMADORES DE FUTSAL

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RESUMO

Objetivo: Verificar a influência dos diferentes tempos de intervalo entre os sprints no desempenho dos atletas de futsal amadores. **Métodos:** 10 indivíduos, homens, atletas de futsal amadores (Idade: 21,5 ± 1,6; Peso: 72,4 ± 6,88; Altura: 1,72 ± 0,05; IMC: 24,3 ± 1,2; Gordura%: 13,7 ± 3,3, VO_{2peak}: 49,1 ± 10,5) participou no estudo. Os indivíduos foram selecionados aleatoriamente para realizar sessões com sprints (10 conjuntos 20 m) com diferentes tempos de pausa de 15 (S15), 30 (S30) e 60 (S60) segundos. Para análise do desempenho, a velocidade (km/h) aplicada a cada sprint foi utilizada e monitorizada por um dispositivo com uma fotocélula (CEFISE Biotecnologia Esportiva®). **Resultados:** Houve uma interação entre velocidade e tempo de intervalo (p = 0,000). Para a condição S15, observou-se uma maior redução no desempenho (p ≤ 0,05), enquanto para S30 e S60, não se observou qualquer redução significativa no desempenho (p > 0,05). Os dados para a área sob a curva mostraram uma diferença significativa (p = 0,000), onde o intervalo de 60 s (S60) foi mais longo em comparação com os valores de 30 (S30) (p = 0,000) e 15 s (S15) (p = 0,000). No entanto, não houve diferenças significativas entre os dados de 30 e 15 s (p = 0,248). **Conclusão:** Um intervalo de tempo mais curto (15 s) entre sprints repetidos pode afetar significativamente o desempenho em comparação com os intervalos mais longos (30 e 60 s), mas todas as condições aqui testadas podem ser positivas para a melhoria do desempenho, principalmente nos desportos que exigem ações motoras rápidas e eficientes, tais como o futsal.
Palavras-chave: treino de sprint repetido; desempenho na velocidade; fisiologia; desporto

ABSTRACT

Objective: 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. Individuals were randomly selected to perform sessions with sprints (10 sets 20 m) with different pause times of 15 (S_{15}), 30 (S_{30}) and 60 (S_{60}) seconds. For performance analysis, the speed (km / h) applied to each sprint was used and monitored by a device with a photocell (CEFISE Biotecnologia Esportiva®). **Results:** There was an interaction between speed and interval time ($p = 0.000$). For condition S_{15}, 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 s (S_{60}) was longer compared to the values of 30 (S_{30}) ($p = 0.000$) and 15 s (S_{15}) ($p = 0.000$). However, there were no significant differences between the 30 and 15 s data ($p = 0.248$). **Conclusion:** A shorter time (15 s) interval between repeated sprints can significantly affect performance compared to longer breaks (30 and 60 s), but all the conditions tested here can be positive for the improvement of performance, mainly in sports that demand fast and efficient motor actions such as futsal.
Keywords: repeated sprint training; speed performance; physiology; sports

Introduction

Interval training [IT] is an excellent method among the different methods of exercise prescription aimed at improving performance, since it can be used for both anaerobic[1] and aerobic stimuli[2]. IT can involve variations in stimuli, intensity, and recovery, and within this context one of the variations widely used in different sports is 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 [RST][6]. SIT is generally used with stimuli of approximately 30 s with passive or active recovery of 2 to 4 min[7]. RST is applied with short stimuli [~3 to 7 s duration] and with passive recovery of up to 60s[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] and seem to be a great strategy to achieve results, optimize training time, and thus protect the individual from injury arising from long training times[5].

The sprints [SIT and RST] belong to the IT method applied with high intensity, popularly termed high intensity interval training [HIIT], the use of which 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 enhance 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 of promoting improvement in mitochondrial density and biogenesis[15,16]. In addition to improvements in glycolytic metabolic behavior and oxidative[17] and cardiovascular functions[18], these mechanisms are 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, correct conduct of training, especially high intensity training, can improve metabolic integration capacity[1,2] and even with shorter intervals there can be a minimization of drastic reduction of performance. Futsal is a sport that demands high motor and physiological efficiency, such as displacement, reaction speed and metabolic integration, in addition to technical components. However, we believe that the application of SIT in futsal is a great strategy to optimize training times and improve physical abilities and skills resulting in better performance with less energy expenditure and mechanical wear. 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.

Methods

Sample

Ten male amateur futsal athletes of the Catholic University of Petrópolis, Rio de Janeiro, Brazil participated in this study [Table 1]. To be included, participants should be free of ostemioarticular lesions, with no history of cardiovascular diseases and be willing to participate without any type of interruption. All participants had at least five years of futsal experience. 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 not use excessive consumption of salt, caffeine or alcohol, in order to avoid interference in cardiovascular responses. All individuals did not undergo training for a week and 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 the Helsinki resolution and was approved by the local Research and Ethics Committee, code CAAE: 800 63917.4.0000.5281.

Table 1. Anthropometric characteristics of the participants

Variables	Participants
	M ± S D
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} ($ml \cdot kg^{-1} \cdot min^{-1}$)	49.1 ± 10.5

Source: authors

Procedures

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] for stratification and sample knowledge. They received the Free and Informed Consent Form [CIF] for the firm and also performed a physical evaluation 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 to direct the level of intensity that would be applied in the experiments. The last three visits were designated for the experimental intervention, the individuals performed sprint sessions [10 × 20 m] 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 an interval of 48 h.

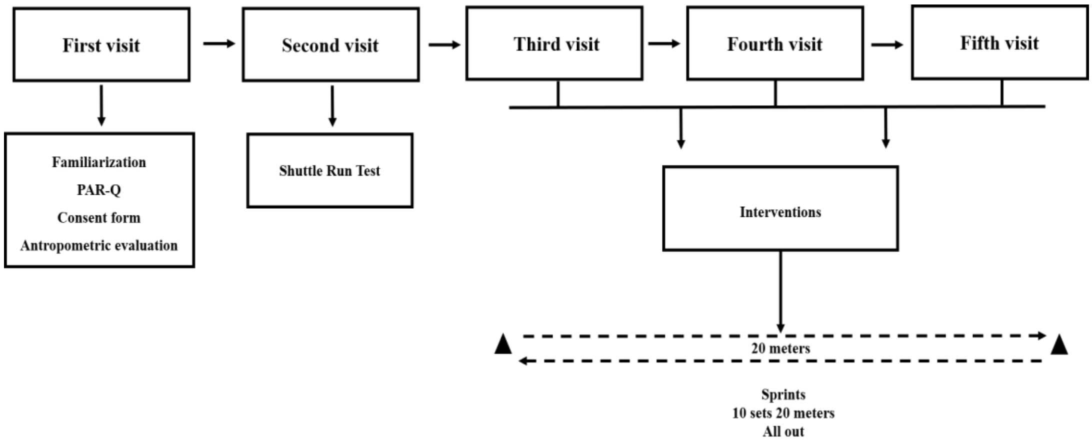

Figure 1. Flowchart of the experimental procedure
Source: authors

Training protocols

In view of the methodological aspects, the interventions of the present study consisted of sessions with repeated sprint training [RST]. Each participant was randomly selected for the experimental visits [S_{15}, S_{30} and S_{60}]. A minimum interval of 48 h was allowed between each visit for the tests. The experiments were carried out in a sports court. Before the performance of the 10 sprints, a 5-min warm-up was performed consisting of: 1: two laps on the court at a moderate pace [40–60% HR_{Max}]; 2: joint heating [3 min]; 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 for the start of the spirits with 10 series of 20 m at full 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: the interval between sprints. For each sprint in each experiment, a 5s countdown [5,4,3,2,1...go!] was conducted by one of the researchers followed by a beep [short hiss] that corresponded to the start of a new sprint.

Performance analysis

Performance analysis was performed through the speed [km/h] reached during the course of each sprint for all conditions [S_{15}, S_{30} and S_{60}]. The speed was measured using a photocell apparatus [CEFISE Biotecnologia Esportiva®, Nova Odessa, São Paulo, Brazil]. For comparative effects, an intraconditional analysis was performed for all sprints as well as interconditional comparisons between them.

Statistical analysis

All results were presented as mean ± standard deviation [SD]. A two-way ANOVA was applied for repeated measures to test for 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 Statistica 7.0 software [Statsoft ™, Tulsa, OK, USA]. For the sample size calculation, the GPower 3.1 software was used.

Results

In response to stratification of the sample, the physical activity readiness questionnaire [PAR-Q] was used. However, all participants [100%] responded negatively to this assessment, which means that the participants had no restrictions on health conditions. Therefore, they were able to safely practice physical exercise. 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].

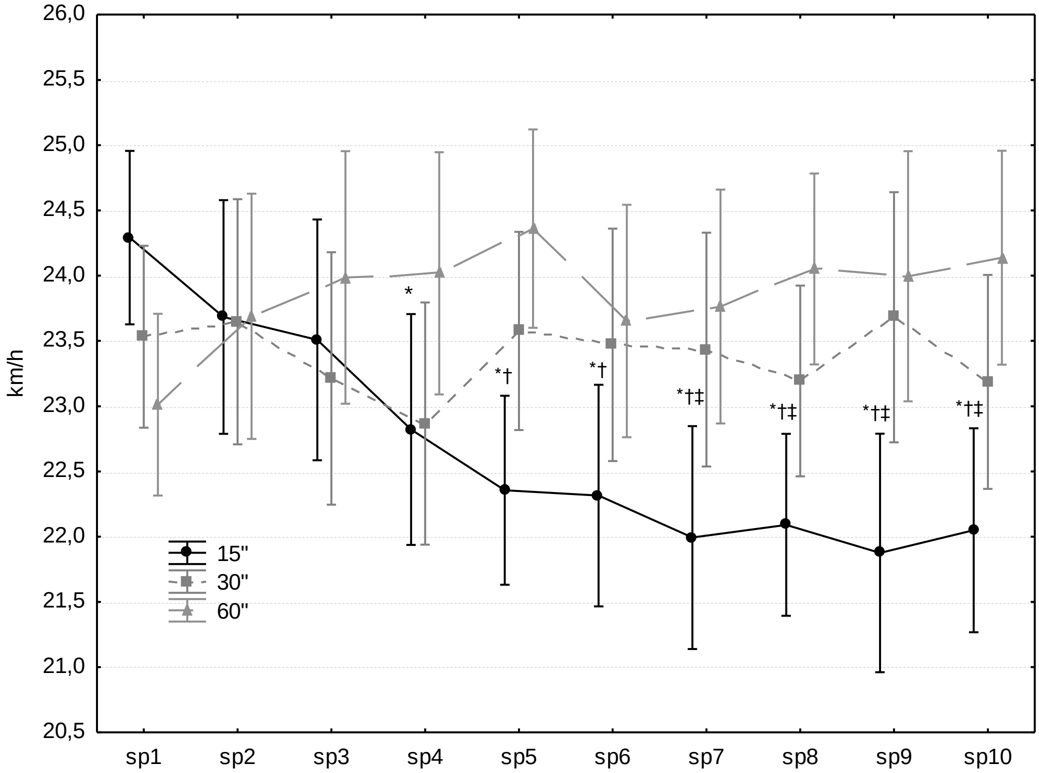

Figure 2. Performance analyses in the sprints for all conditions.
Notes:* Significant difference in relation to the initial sprint (SP1); † Significant difference in relation to the second sprint (SP2); ‡ Significant difference in relation to the third sprint (SP3)
Source: authors

The data for ASC [Figure 3] showed a significant difference [p = 0.000], where the interval of 60 s [S_{60}] was longer compared to the values for 30 [S_{30}] [p = 0.000] and 15 s [S_{15}] [p = 0.000]. However, there were no significant differences between the 30 and 15 s data [p = 0.248].

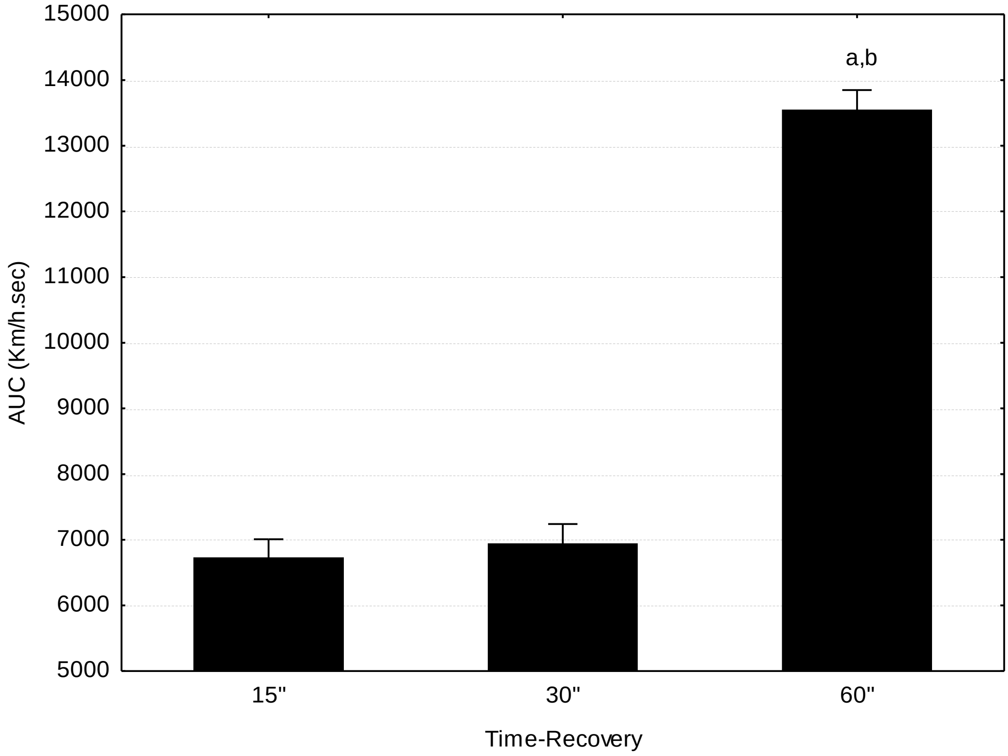

Figure 3. Analysis of the area under the curve for all conditions
Notes: [a] Significant difference in relation to ASC from the 15s interval condition. [b] Significant difference in relation to ASC from the 30-s interval condition
Source: authors

Discussion

The aim of the present study was to verify the influences of different intervals [15, 30 and 60s] 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 [15s–S_{15}] when compared to the other interval conditions [30s–S_{30} and 60s–S_{60}]. Through analysis using the area under the curve [ASV], it was observed that 60s [S_{60}] of pause could be a great option for maintenance of performance, specifically in short sprints [20 m] with maximum speed or supramaximal [all-out].

This research considered performance analysis through speed applied in consecutive sprints [10 sets × 20 m]. Previous studies compared performance through applied power[20,21] and time[22]. With speed, the studies were discreet and inconclusive. Considering that this variable (speed) is extremely important for performance evaluation, especially when it comes to futsal athletes, it is important to note that the participants were amateurs. Balson et al.[23], observed in three different series and stimulus protocols [40 × 15 m, 20 × 30 m and 15 × 40 m], but with equal pause intervals [30s], that the protocols with fewer series, but with greater distance for the sprint [30 and 40m] 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 suggest that tension time be considered at the time of prescription, since this variable can be manipulated by the stimulus time and, consequently, by the shorter recovery time which, together, would influence energy reserves.

Gaitanos et al.[19], observed a significant reduction in the final sprints [10 × 6s] with 30s intervals, which, even analyzing different variables, does not corroborate the findings of this study, where for the 30-s interval [S_{30}] no significant differences were identified. However, the present research evaluated running sprints and the above-mentioned study carried out interventions on a cycle ergometer. Therefore, we cannot extrapolate these results to generalize the repercussions of 30s breaks. Similarly, Glaister[22] used different intervals [10 and 30s] between sprints of 5s [20 sets] and observed that with 10 s performance reduction in the average applied power was greater. So, a shorter interval generated a greater loss of performance, demonstrated through speed. Studies that verify inter sprints performance are scarce, limiting deductions that can be made on this type of intervention, especially when there are different recovery intervals.

Interventions using sprints can be great strategies for improving autonomic function[25,26] cardiac function through better chemical reactions[21] and structural[23], in addition to cardiopulmonary, improvements[4]. Studies have found that sprint interventions can also be a great option for improving performance evaluated through mountain bike race simulations[9] and several other tests, such as squat jumps, countermovement jumps, sprinting speed [5, 10, 20 and 30m], change of direction and speed tests[24].

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 indicated that physiological parameters are directly linked to performance, such as improvement of the cardiovascular system through better activation and autonomic balance (sympathetic vs. parasympathetic)[25]. With all out sprints there is an increase in blood flow and, consequently, an increase in the levels of nitric oxide in endothelial structures, balancing blood pressure and generating better vascularization[18] due to greater vasodilation and arterial compliance[26].

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[22], 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. The level of the participating athletes [amateurs] and the sample size, in fact, was our major limitation. There is significant difficulty in recruiting athletes for analyses of this type of study and that is why we had a limited number and a nonprofessional population. Another limitation was that we did not measure lactate levels before and after interventions. This way, we would have had 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 times, due to the conditional gains resulting from the sessions with sprints.

The findings of the present study were obtained using a population of amateur futsal athletes. Therefore, we cannot extrapolate these results to professional athletes, but we can suggest that SIT can be a great tool and training strategy for this modality. However, the results for higher levels of athletes are inconclusive. Therefore, we suggest other studies on the same theme with professional athletes to evaluate the physiological and mechanical responses resulting from the application of SIT.

Conclusion

In view of the findings, we conclude that a shorter time [15s] of pause between repeated sprints can affect performance more significantly compared to longer pauses [30 and 60s]. However, for practical applicability, prescriptions with shorter recovery times may be feasible when there is an interest in manipulating higher intensity through the use of denser training. While sprint sessions with longer pauses can be applied when there is an intention to do an intense workout in a block [e.g., one week], where all training is conducted at high intensities, longer pauses mean the individual's chances of injury may be less. 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.

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