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CAPACITY OF REPEATED SPRINTS IN PROFESSIONAL FUTSAL ATHLETES: AN ANALYSIS OF THE TABATA PROTOCOL

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ABSTRACT

Futsal seems to require a high amount of high intensity efforts and the ability to generate repeated sprints justifies the athlete's ability to maintain maximum effort over repeated sprints, a feature that is indispensable for the sport. Objective: to evaluate the ability of repeated sprints (TSR) in futsal players in an analysis considering the Tabata *training protocol.* Materials and Methods: Cross-sectional p, composed of nine athletes from a futsal team from Paranavaí, Paraná, Brazil who was currently competing in the silver series (second division) of the state championship. Only players who act on the line are selected. Aerobic capacity was evaluated by the intermittent 30:15 test and the after 48 h, the athletes were recruited to perform the Tabata protocol of high intensity interval training, which originally consists of eight sprints of 20 seconds at 170% of the maximum vVO_2, interspersed by 10 seconds of passive recovery. In each sprint, the subjective perception of exertion (PSE), speed and percentage of the maximum vVO_2 were noted. Results: The reported PSE values by the athletes increased with each sprint performed, and all athletes finished with maximum perception of effort. Another important data shows that five of the nine athletes evaluated, managed to perform only the first sprint in the intensity of the protocol, so the final average of the percentage of the maximum vVO_2 was 121.96 ± 9.32 %. Conclusion: Professional futsal players were not able to perform the Tabata *training protocol at the intensity* proposed by the author (170% maximum vVO_2), as well as had significant loss in running speed and significant increases in PSE, with 100% of the players reported maximum effort at the end of the protocol.

Key word: High-Intensity Interval Training. Athletes. Athletic Performance.

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RESUMO

Capacidade de sprints repetidos em atletas profissionais de futsal: protocolo tabata

O futsal parece exigir uma grande quantidade de esforços de alta intensidade e a capacidade de gerar tiros repetidos justifica a capacidade do atleta de manter o esforço máximo ao longo de tiros repetidos, característica indispensável para o esporte. Objetivo: avaliar a capacidade de sprints repetidos (TSR) em jogadores de futsal numa análise considerando o protocolo de treinamento Tabata. Materiais e Métodos: Corte transversal p, composto por nove atletas de uma equipe de futsal de Paranavaí, Paraná, Brasil que disputava atualmente a série prata (segunda divisão) do campeonato estadual. Apenas os jogadores que atuam na linha são selecionados. A capacidade aeróbica foi avaliada pelo teste intermitente 30:15 e após 48 h os atletas foram recrutados para realizar o protocolo Tabata de treinamento intervalado de alta intensidade, que originalmente consiste em oito sprints de 20 segundos a 170% do vVO_2 máximo, intercalados por 10 segundos de recuperação passiva. Em cada sprint foram anotadas a percepção subjetiva de esforço (PSE), velocidade e percentual da vVO_2 máxima. Resultados: Os valores de PSE relatados pelos atletas aumentaram a cada sprint realizado, e todos os atletas terminaram com percepção máxima de esforço. Outro dado importante mostra que cinco dos nove atletas avaliados conseguiram realizar apenas o primeiro sprint na intensidade do protocolo, portanto a média final do percentual do vVO_2 máximo foi de 121,96 ± 9,32%. Conclusão: Os jogadores profissionais de futsal não conseguiram realizar o protocolo de treinamento Tabata na intensidade proposta pelo autor (170% vVO_2 máximo), bem como tiveram perda significativa na velocidade de corrida e aumentos significativos na PSE, sendo que 100% dos jogadores relataram esforço máximo no final do protocolo.

Palavra-chave: Treinamento Intervalado de Alta Intensidade. Atletas. Performance atlética.

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INTRODUCTION

In futsal, competitive games impose intermittent and high intensity demands that require physical, technical and tactical efforts from athletes added to the repeated maximal sprints(Naser et al., 2017) that are performed between intervals of 57 and 79 s(Barbero-Alvarez, Hermoso, Granda-Vera, 2004; Castagna et al., 2009).

The average distance of each sprint is approximately 10.5 m, with an approximate duration of 1.9 s and recovery intervals between sprints < 40 s (Castagna et al., 2009).

During a match, futsal athletes travel an average of 4,313 m, and 8.9% (348 m) of this distance is covered by sprints (speed ≥ 25 km/h) (Barbero-Alvarez et al., 2008).

There are reports that futsal athletes perform approximately 26 sprints per match and in some situations two sprints are performed consecutively with intervals of approximately 15s (Castagna et al., 2009). The authors also observed sequences of three and four sprints with intervals of approximately 30, 45 or 60 s.

The intermittent and high intensity characteristics of futsal require high levels of aerobic power from athletes, so that recovery between high intensity efforts or even after exhaustion is facilitated(Helgerud et al., 2001; Tomlin, Wenger, 2001).

In addition, to compete at a high level it is necessary that a futsal athlete present great production and maintenance capacities of the speed of repeated sprints, actions that impose high demands on anaerobic and aerobic energy pathways (Naser et al., 2017).

The ability of repeated sprints (TSR) in futsal athletes can be optimized by high intensity interval training, including through the protocol proposed by Tabata et al., (1996) which consists of performing seven to eight sets of 20 s of exercise with intensity of approximately 170% of the maximum oxygen consumption (VO_2 max) with recovery intervals of 10 s between each stimulus. After six weeks of training performed five days a week, individuals submitted to this protocol presented substantial increases in VO_2 max and anaerobic capacity(Tabata et al., 1996).

The benefits provided by the Tabata protocol could optimize the performance of futsal athletes, however, they may present difficulties in performing this training model, especially with regard to maintaining intensities close to 170% of VO_2 max during exercise.

Previous studies question the feasibility of such protocol given the demand imposed by an accumulation of 160 s of work at 170% of VO_2 max in a 2:1 pause effort ratio (20 s of work and 10 s of interval) (Viana et al., 2019).

In view of the above, the present study aimed to evaluate the ability of repeated sprints (TSR) in futsal athletes during the Tabata protocol.

MATERIALS AND METHODS

Experimental design and sample

The present study is characterized as cross-sectional research with nine of the 18 athletes (fixed, wards and pivots) of a professional futsal team from the municipality of Paranavaí-PR who at the time competed in the Silver Series (second division) of the Paraná championship.

All tests were performed within 14:00, and all athletes were previously familiar with the test for at least one pre-test. This investigation was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee (Process 3,767,270).

Anthropometric measurements

Height was determined from the use of a wall station (Wiso® E210, São José, Santa Catarina, Brazil) with a resolution of 0.1 cm. Body mass was estimated in digital scale (G-Tech® Glass Pro, Zhongshan, Guangdong, China) with a maximum capacity of 150 kg and resolution of 100 g. During the procedures, the evaluated women wore only the training uniform (shorts and t-shirt). Based on these measurements, the Body Mass Index (BMI) was calculated by the ratio between body mass (kg) and height square (m).

Aerobic capacity

Aerobic capacity was assessed by intermittent 30:15 test, which consists of 30-s interval sprints for passive recovery periods of 15 s. The test started at 8 km/h for the first 30 s of running with increments of 0.5km/h at each stage of 30 s.

Athletes ran between two lines separated by a distance of 40 m at a rate determined by a bipepe Prerecorded. The pre-recorded beep offered conditions for athletes to adjust the speed of the race.

During the recovery period of 15 seconds, the athletes walked forward towards the nearest line (in the middle or at the ends of the running area) and from this line they started the next stage of the test.

The athletes were instructed to complete as many stages as possible. The test ended when the athletes failed to maintain the required running speed or when they were unable to reach a 3 m zone (in the middle or at the ends of the test area) three times in a row. The speed achieved during the last completed phase was determined as maximum vVO_2 m and the aerobic capacity determined from equation: 28.3 - (2.15*1) - (0.741*age) - (0.0357*body mass) + (0.0586 *age*vVO_2 maximum) + (1.03*vVO_2 maximum) (Buchheit, 2008).

Ability to repeat sprints (RST)

After 48 h of the initial collection, the athletes were recruited to perform the Tabata protocol of high intensity interval training (Tabata et al., 1996).

To control the race intensity of the athletes, the distance to be traveled during the efforts was determined in meters and demarcated with a cone at each end of the running area. In each of the sprints, the modified subjective perception of exertion (PSE) (Foster et al., 2001), the speed and percentage of vVO_2 max were recorded.

Statistical analysis

Data normality was confirmed from the Shapiro-Wilk test and standardized values of asymmetry and shortness (±2Z), while variance homogeneity will be evaluated by *the Levene test*. Descriptive statistics were used with mean and standard deviation values.

The Mauchly test was adopted to verify the measurement of the data. In cases where the spartoricity was violated, the Greenhouse Geisser correction was adopted. Variance analysis (ANOVA) was used for the mean scan scans between each sprint. The Bonferroni *post hoc* test was used when a significant F-ratio was identified. All analyses were processed and performed through *the Statistical Package for a Social Science* (SPSS Inc., Chicago, IL, USA), version 20.0.

RESULTS

Table 1 shows the anthropometric characteristics of the sample, cardiorespiratory fitness (VO_2 max), the velocity corresponding to 170% of the speed achieved during the determination of VO_2 max (vVO_2 max) and the distance to be traveled to perform the Tabata protocol.

Table 1 - Profile of the sample for Tabata Protocol (n = 09).

Variables	Mean ± SD
Age (years)	21. 22 ± 3. 73
Body Mass (kg)	1. 70 ± 0. 05
Height (cm)	66. 33 ± 12. 7
IMC (Kg/m^2)	22. 76 ± 3. 44
VO_2 maximum (ml.kg.min)	43. 52 ± 3. 64
sVO_2 max (km/h)	15. 67 ± 1. 64
Speed at 170% of maximum vVO_2 (km/h)	26. 63 ± 2. 81
Distance from efforts (m)	147. 96 ± 15. 48

SD: Standard Deviation; BMI: Body Mass Index; s: Speed.

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Figure 1 shows the behavior of the PSE, the speed and the percentage of vVO2max during each of the sprints performed by the athletes throughout the Tabata protocol.

The PSE increased with each sprint performed and statistically significant differences were observed between the second and third sprint, in addition, all athletes finished the Tabata protocol with PSE 10 on the 0-10 scale.

The velocity, in turn, showed a gradual decrease with each sprint performed with statistically significant differences between all sprints, except from the sixth to the seventh and from the seventh to the eighth.

The percentage of vVO_2 max also showed a gradual reduction with each sprint performed with statistically significant differences from the first to the second, from the second to the third, from the third to the fourth and from the fourth to the fifth sprint.

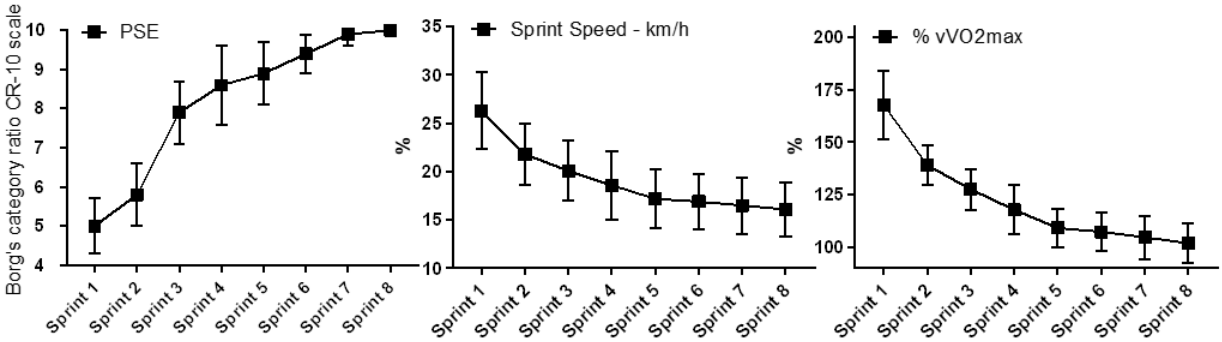

Figure 01 - PSE behavior, speed and percentage of the maximum vVO_2 of the Tabata protocol by professional futsal athletes (n = 09).

Table 2 shows the performance of professional futsal athletes in performing the Tabata protocol. Only 5 of the 9 athletes submitted to the Tabata protocol were able to perform one of the eight sprints at 170% of vVO_2 max.

The others were even able to complete one of the eight sprints at 170% of vVO_2 max.

The speed showed a reduction of approximately 10 km/h at each sprint and the session average was 18.4 km/h, in addition, there were reductions in the order of 65.8% of vVO_2 max between first and eighth sprint, finally, the average PSE of athletes submitted to the Tabata protocol was 8.1.

Table 2 - Characteristics of the Tabata protocol by professional futsal athletes (n = 09).

Variables	Average ± SD
Number of sprints completed at 170% of maximum vVO_2	0,67 ± 0,50
Δ speed (km/h)	-10,28 ± 2,32
Δ percentage of maximum vVO_2 (%)	-65,83 ± 15,11
PSE	8,18 ± 0,46
Speed (km/h)	18,44 ± 2,48
Maximum vVO_2 percentage (%)	

Δ: Delta; PSE: Subjective perception of effort.

DISCUSSION

The present study aimed to evaluate the ability of TSR in futsal athletes during the Tabata protocol. Our results indicate that this training protocol imposes great difficulties on futsal athletes, especially with regard to the maintenance of good performance levels, given that there were marked reductions in speed and vVO_2 max in addition to a significant increase in PSE in the first sprints performed. The performance improvement occurred throughout

the entire training session at each sprint and was accompanied by gradual increases in the PSE (all athletes finished the session with PSE 10 on the 0-10 scale).

Despite the reports about the efficiency of the training protocol proposed by Tabata et al., (1996) with regard to the benefits for physical fitness with considerably short training sessions, the findings of a systematic review of the literature revealed that after 21 years (1996-2017) few studies replicated training protocols that approached the authors' original proposal.

The original protocol performed in cycle ergometer can induce higher levels of stress to the anaerobic system in addition to potentiating peripheral fatigue, thus, most participants interrupt the exercise in the third of the eight series of effort performed in cycle ergometer when the prescribed intensity corresponds to 170% of VO_2 max (Viana et al., 2019).

On the other hand, the use of running could provide increases in oxygen consumption (VO_2) with a lower degree of peripheral fatigue (Viana et al., 2019) however, the results of the present study demonstrate that the level of physical requirement to perform efforts at 170% of vVO_2 max over 20 seconds with only 10 s interval between efforts increased the ability of futsal athletes, who were unable to complete the RST sequence proposed by the Tabata protocol.

The inability of futsal athletes to complete the RST sequence can be explained, at least in part, by fatigue caused by limitations of anaerobic and aerobic energy metabolism, by intramuscular accumulation of metabolic by-products (Bishop, Girard, Mendez-Villanueva, 2011; Girard, Mendez-Villanueva, Bishop, 2011) and, due to decreases in torque production of knee extensor and flexor muscles (Dal Pupo et al., 2017) caused by the performance of RST.

It is possible that aerobic fitness may also have negatively influenced the RST capacity of futsal athletes participating in the present study during the Tabata protocol.

Previously, Gharbi et al., (2015) examined the relationship between RST and the components of anaerobic and aerobic fitness in team sports athletes and concluded that aerobic fitness is an important factor that influences the ability of athletes to resist fatigue during RST. The participants of the present study presented mean VO_2 max values of 43.5 ml.kg.min, on the other hand, previous studies that analyzed physiological characteristics of elite futsal athletes found mean VO_2 max values between 48.6 and 65.1 ml.kg.min (Spyrou et al., 2020).

It is noteworthy that in this type of training, aerobic metabolism is dominant(Del Vecchio et al., 2020), but the anaerobic contribution is crucial to asuccessful performance. However, the moment-to-moment demand of team games requires a high and remarkable component of maximum intensity, making it significantly the steadystate of exercise.

After intense periods of activity during team games, the decrease inmuscle PCr concentration is correlated with impaired running capacity(Mohr, Krustrup, Bangsbo, 2005; Krustrup et al., 2006).

However, the depletion of muscle PCr after periods of high intensity in collective jogos seems to be moderate(Bangsbo, Iaia, Krustrup, 2007), and other studies showed no changes in muscle PCr concentration at the end of intermittent tests designed to replicate the repeated sprint nature of team games (Krustrup et al., 2003).

Thus, andin practical aspects, the fatigue behavior seems to be different when taking into account the specific aspects of a timed training such as the Tabata and the dynamics of repeated sprints imposed by the game.

The relative importance of central fatigue for exercise performance becomes greater the longer the exercise to continue (Ghorbani, Clark, 2021).

It would therefore be expected that this central fatigue would have minimal impact on short distance races.

Thus, we analyze the behavior of the subjective perception of exertion (PSE) of the athletes in the present study, the results showed that all athletes finished the session with PSE 10 on the 0-10 scale, as well as moderately active young men submitted to the Tabata protocol by Follador et al., (2018) (PSE 9.9).

The authors report that none of the participants were able to sustain the previously planned intensity and that the high levels of PSE can be attributed by the short duration of recovery intervals between efforts (Follador et al., 2018), despite the short training time.

As in most studies, the design of the current study is subject to some limitations, such as the sample' morning, because we evaluate d'or thus only one futsal team and thus the results require caution when being or transferred to all athletes of the modality.

Another limiting factor was the scarcity of studies analyzing the ability of sprints in futsal athletes and thus comparations, and explanations of the results of this research could be better elucidated. Thus, new research involving futsal athletes and the ability of repeated sprints deserve attention in the scientific literature.

CONCLUSION

Professional futsal players were not able to perform the Tabata training protocol at the intensity proposed by the author (170% maximum vVO_2), as well as had significant loss in running speed and significant increases in PSE, with 100% of the players reporting n of the maximum effort at the end of the protocol.

Thus, replicating the Tabata protocol as originally described by the author, in relation to the time and intensity aspects in professional futsal athletes seems unlikely.

Thus, including training sessions with sprints d and20 seconds and recoveries of 10 seconds, requires significant adjustments in the intensity of running, or if the coach wants to maintain the suggested intensity, the time aspects need to be reviewed, however in both ways the decharacterization of the protocol is evident.

Despite the important findings of this research, future investigations need to be carried out with representative samples of athletes to extrapolate the results and elucidation of the potential mechanisms of fatigue during the protocol.

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