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REPEATED SPRINT ABILITY IN PROFESSIONAL MALE FUTSAL ATHLETES: AN ANALYSIS OF TABATA PROTOCOL

KEY WORDS: High-Intensity Interval Training; Athletes; Athletic Performance.

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ABSTRACT

The study aimed to evaluate the RSA in futsal athletes during Tabata protocol. Cross-sectional investigation, composed of nine professional male futsal athletes, who were currently competing in the silver series of the state championship. Only players who acted on the line (fixed, wings and pivots) were selected. Aerobic capacity was evaluated by intermittent 30:15 test and after 48 h, athletes were recruited to perform Tabata protocol of high intensity interval training, which originally consists of eight sprints of 20s at 170% of the maximum vVO2, interspersed by 10s of passive recovery. In each sprint, the rating of perceived exertion (RPE), speed and percentage of the maximum vVO2 were registered. The reported RPE by the athletes significantly increased after each sprint performed, and all athletes finished with maximum perception of effort. There were no significant differences in the RPE only between the four/five, five/six and seven/eight sprints. In regard to running speed, only six-for-seven and seven-for-eight sprints showed no significant differences. Another important data showed that five of the nine athletes evaluated managed to perform only the first sprint in the intensity of the protocol, so final average of the percentage of the maximum vVO2 was 121.96 ± 9.32 %. Professional futsal athletes were not able to perform Tabata training protocol at the intensity proposed by the authors (170% maximum vVO2), as well as had significant loss in running speed and significant increases in RPE, with 100% of the players reporting maximum effort at the end of the protocol.

INTRODUCTION

In futsal, competitive games impose intermittent and high intensity demands that require physical, technical and tactical efforts from athletes, not to mention the repeated maximal sprints[1] that are performed between intervals of 57 and 79 s[2-3]. 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[3]. During a match, futsal athletes run an average of 4,313 m, and 8.9% (348 m) of this distance is covered by sprints (speed ≥ 25 km/h)[4]. 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 fifteen seconds[3]. 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[5-6]. In addition, to compete at a high level it is necessary that a futsal athlete presents great production and maintenance capacities of the speed of repeated sprints, actions that impose high demands on anaerobic and aerobic energy pathways[1].

The repeated sprint ability (RSA) in futsal athletes can be optimized by high intensity interval training, including through the protocol proposed by Tabata et al.[7], which consists of performing seven to eight sets of 20 s of exercise with intensity of approximately 170% of the maximum oxygen consumption (VO2max) with recovery intervals of 10 s between each set. After six weeks of training performed five days a week, the subjects submitted to this protocol presented substantial increases in VO2max and anaerobic capacity[7].

The benefits provided by 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 VO2max during exercise. Previous studies questioned the feasibility of such protocol, given the demand imposed by an accumulation of 160 s of work at 170% of VO2max in a 2:1 pause effort ratio (20 s of work and 10 s of interval)[8]. Thus, the present study aimed to evaluate the RSA in futsal athletes during Tabata protocol.

METHODS

Experimental Design and Sample

The present study was composed of nine of the 18 athletes (fixed, wards and pivots) of a professional futsal team from Paranavaí, Paraná, Brazil, who at the time competed in the Silver Series (second division) of Paraná championship. All tests were performed at 2 p.m., and athletes were previously familiarized 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).

Anthropometry

Height was determined with a wall station (Wiso® E210, São José, Santa Catarina, Brazil) with a resolution of 0.1 cm. Body mass was measured in a calibrated electronic scale (G-Tech® Glass Pro, Zhongshan, Guangdong, China) with a maximum capacity of 150 kg and resolution of 100 g. During the procedures, the athletes wore only the training uniform (shorts and t-shirt). Body Mass Index (BMI) was calculated by the ratio between body mass (kg) and square root of height (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 0.5 km/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 pre-recorded beep. The pre-recorded beep offered conditions for athletes to adjust the speed of the run. During the recovery period of 15 s, athletes walked forward towards the nearest line (in the middle or at the end of the running area) and from this line they started the next stage of the test. Athletes were instructed to complete as

many stages as possible. The test ended when 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 end of the test area) three times in a row. The speed achieved during the last completed phase was determined as maximum vVO2m and the aerobic capacity determined from equation: 28.3 - (2.15*1) - (0.741*age) - (0.0357*body mass) + (0.0586 *age*vVO2 maximum) + (1.03*vVO2 maximum)[9].

Repeated Sprint Ability (RSA)

After 48 h of the initial collection, the athletes were recruited to perform Tabata protocol of high intensity interval training7. To control the running intensity of the athletes, the distance to be covered 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 rating of perceived exertion (RPE)[10], the speed and percentage of vVO2max were recorded.

Statistical Analysis

Normality was checked by the Shapiro-Wilk's test. Data were expressed as means and standard deviations. Levene's test was used to analyze the homogeneity of variances. Analysis of variance (ANOVA) for repeated measures was used for comparisons. In variables where sphericity was violated as indicated by Mauchly´s test, the analyses were adjusted using a Greenhouse-Geisser correction. When an F-ratio was significant, Bonferroni's post hoc test was employed to identify mean differences.

For all statistical analyses, significance was accepted at $P < 0.05$. The data were stored and analyzed using Statistical Package for a Social Science software version 20.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Table 1 shows the anthropometric characteristics of the sample, cardiorespiratory fitness (VO2max), speed corresponding to 170% of maximum vVO2 and total distance covered during 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
BMI (Kg/m²)	22. 76 ± 3. 44
VO2 maximum (ml.kg.min)	43. 52 ± 3. 64
sVO2 max (km/h)	15. 67 ± 1. 64
Speed at 170% of maximum vVO2 (km/h)	26. 63 ± 2. 81
Total distance covered (m)	147. 96 ± 15. 48

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

Figure 1 shows the behavior of the RPE, the speed and the percentage of vVO2max during each of the sprints performed by the athletes throughout Tabata protocol. RPE significantly increased with each sprint performed and statistically significant differences were observed between the second and third sprint, in addition, all athletes finished Tabata protocol with RPE at 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 vVO2max 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.

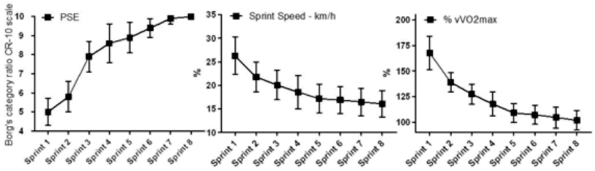

Figure 1. PSE Behavior, Speed And Percentage Of The Maximum vVO2 Of The Tabata Protocol By Professional Futsal Athletes (n = 09).

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 vVO2max. The others were even able to complete one of the eight sprints at 170% of vVO2max. 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 vVO2max between first and eighth sprint, finally, the average RPE of athletes submitted to Tabata protocol was 8.1.

Table 2. Characteristics Of Tabata Protocol By Professional Futsal Athletes (n=09).

Variables	Average ± SD
Number of sprints completed at 170% of maximum vVO2	0,67 ± 0,50
Δ speed (km/h)	-10,28 ± 2,32
Δ percentage of maximum vVO2 (%)	-65,83 ± 15,11
RPE	8,18 ± 0,46
Speed (km/h)	18,44 ± 2,48
Maximum vVO2 percentage (%)	

Note. Δ: Delta; RPE: Rating of perceived exertion.

DISCUSSION

The present study aimed to evaluate the ability of TSR in futsal athletes during Tabata protocol. Our results indicated that this training protocol imposes great difficulties on futsal athletes, especially with regard to the maintenance of good performance levels, given that there were significant reductions in speed and vVO2max in addition to a significant increase in RPE 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 RPE (all athletes finished the session with RPE at 10 on the 0-10 scale).

Despite the reports about the efficiency of the training protocol proposed by Tabata et al.[7] 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 VO2max[8].

On the other hand, the use of running could provide increases in oxygen consumption (VO2) with a lower degree of peripheral fatigue[8], however, the results of the present study demonstrated that the level of physical requirement to perform efforts at 170% of vVO2max over 20 s 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[11-12] and, due to decreases in torque production of knee extensor and flexor muscles[1]3 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.[14] 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 VO2max values of 43.5 ml.kg.min, on the other hand, previous studies that analyzed physiological characteristics of elite futsal athletes found mean VO2max values between 48.6 and 65.1 ml.kg.min[15].

It is noteworthy that in this type of training, aerobic metabolism is dominant[16], but the anaerobic contribution is crucial to a successful performance. However, the moment-to-moment demand of team games requires a high and remarkable component of maximum intensity, making it significantly the steady state of exercise.

After intense periods of activity during team games, the decrease in muscle PCr concentration is correlated with impaired running capacity[17-18]. However, the depletion of muscle PCr after periods of high intensity in collective games seems to be moderate[19], 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[20]. Thus, in practical aspects, the fatigue behavior seems to be different when taking into account the specific aspects of a timed training such as Tabata protocol 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[21]. Therefore, it would be expected that this central fatigue would have minimal impact on short distance races. Thus, we analyzed the behavior of RPE of the athletes in the present study, and the results showed that all athletes finished the session with RPE at 10 on the 0-10 scale, as well as moderately active young men submitted to Tabata protocol by Follador et al.[22] (RPE at 9.9). The authors reported that none of the participants were able to sustain the previously planned intensity and that the high levels of RPE could be attributed to the short duration of recovery intervals between efforts[22], despite the short training time.

As in most studies, the design of the current study has some limitations, such as the sample' morning, because we evaluated 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 Tabata training protocol at the intensity proposed by the authors (170% maximum vVO2), as well as had significant loss in running speed and significant increases in RPE, with 100% of the players reporting the maximum effort at the end of the protocol.

Thus, replicating Tabata protocol as originally described by the authors, 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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