Progress in Nutrition 2021; Vol. 23, Supplement 2: e2021255 DOI 10.23751/pn.v23iS2.11883 

Original article

# The effect of Tabata training program on physical and motoric characteristics of soccer players

*Yakup Akif Afyon [1] Olcay Mulazimoglu[1], Sinan Celikbilek[1], İbrahim Dalbudak[2], Cagan Kalafat [1]*

[1]Mugla Sitki Kocman University, Faculty of Sports Science, Mugla, Turkey; [2]Atabey Vocational School, Isparta University of Applied Sciences, Isparta, Turkey.

**Abstract.** *Study Objectives:* The aim of this study was to examine the effect of Tabata training on some motoric performances of soccer players. *Methods:* Eighteen male amateur soccer players voluntarily participated in the study. The selected participants were randomly divided into two groups 'EG' (age: 22.78±3.38 years) underwent Tabata Training (TT) group (n=9) and group 'CG' (age: 21.44±2.30 years) acted as control group (n=9). In addition to their regular training, EG performed eight different core and plyometric exercises, each of which lasted for 4 minutes, as 20 seconds of work and 10 seconds of recovery. CG was not exposed to any specific training but they participated in regular activities. The following variables were selected to determine the effect of TT on the physical and motoric characteristics of the players: body fat percentage (BF%), standing long jump (SLJ), sit-and-reach test (SRT), flamingo balance test (FBT), back strength (BS), leg strength (LS) and zig-zag agility test (ZAT). The data were obtained from these tests of both group players with the pre-test and post-test methods. After performing normal distribution tests of all data, pre-post-test comparison analyses were interpreted at .05 significance level. *Results:* There was a significant difference between EG's SLJ, BS and LS pre and post-tests averages ($p<.05$). There was a significant difference between CG's BS pre and post-tests averages ($p<.01$). *Conclusion:* Eight-week TTs have improved players' strength characteristics. However, although there was an improvement in skills such as flexibility, balance and agility, it was not at a significant level.

**Key words:** Tabata training, Strength, Flexibility, Balance, Agility

## Introduction

Tabata training has been recognized as one of the high-intensity 'interval or intermittent' (HIIT) methods that differ significantly in exercise mode, intensity, and work-recovery times. HIIT generally requires "near-maximal" submaximal effort performed at an intensity that produces >80% (usually 85-95%) of maximum heart rate (1). The improvement of the body's maximal oxygen uptake ($VO_{2max}$) after high-intensity interval training is linearly related to the oxygen demand of the high-intensity interval training that indicating exercise intensity is a key factor for the improvement of the body's maximal aerobic power (2).

The first study of Tabata training (TT) using, Six weeks of TT was found to increase the maximal accumulated oxygen deficit. This training consisted of 4 days/week of exhaustive TT exercises (7–8 sets to exhaustion) and 1 day/week of 30 min of continuous exercise at 70% $VO_{2max}$ and four subsequent sets of the TT protocol, which was not exhaustive (3).

Many previous studies have demonstrated the contribution of athletes to the development of aerobic and anaerobic capacity. The TT methods used in these

studies were examined according to time, repetition, set and movement characteristics and the developments in the athletes were evaluated (4).

In a recent study, Setiawan, et al. (5) reported the positive effect of TT on the strength, agility and speed development of hockey players. Nitin et al. (6) the positive effect of TT on the strength, agility and speed development of hockey players has been reported. Somade and Nikam (7) concluded that Tabata Protocol is an effective treatment protocol for recreational football players. Lower extremity explosive strength and effort level were both clinically and statistically improved. Ajayaghosh (8) exposed that the experimental group had a significant difference in all the selected variables such as speed and speed endurance to compare the control group. Hence it was concluded that Tabata sprint training enhanced speed and speed endurance among footballers. Dupont et al. (9) the high-intensity interval training have shown that maximal aerobic speed was improved (+8.1±3.1%; p<.001) and that the time of the 40-m sprint was decreased (-3.5±1.5%; p<.001), whereas no change in either parameter was observed during the control period. This study shows that improvements in physical qualities can be made during the in-season period. The method of this study included work-recovery intervals such as TT.

In the present study, the effect of Tabata training applied to amateur football players for eight weeks on the strength, power, flexibility, balance and agility skills of the players was investigated.

## Materials and Methods

### *Participants*

Eighteen male amateur football players, randomly nine experiments (age: 22.78±3.38 years, weight: 69.34±6.08 kg, height: 174.56±5.00 cm) and nine controls (age: 21.44±2.30 years, weight: 73.22±6.38 kg, height: 179.33±6.87 cm) were divided into two groups.

Written informed consent was obtained from all the participants were notified of the research procedures, requirements, benefits, and risks before giving informed consent. The study was conducted in a manner consistent with the institutional ethical requirements for human experimentation in accordance with the Declaration of Helsinki.

### *Tabata training (TT) and experimental design*

Participants in both groups, who were players of the same team, continued their regular training (4 days per week). In addition, EG players applied TT for 8 weeks at the end of regular training 3 days a week. They performed 2 sets of the exercise, one of which consisted of 8 different movements and lasted for 4 minutes. TT consisting of 8 stations was applied in the form of 20 sec working and 10 sec active recovery interval method. 2 minutes rest between sets.

EG and CG test for strength, agility, flexibility before and after the eight-week Tabata Training. Before the 8-week TT program, all participants performed physical and motoric tests. The experimental and control groups did their regular soccer training. The experimental group applied additional TT for 8 weeks. At the end of 8 weeks, both groups performed the physical and motoric tests again with the same protocol.

### *Anthropometric Measurements*

Anthropometric measurements included height, body mass, and percentage of body fat. A wall stadiometer (SECA, Germany) was used to measure height, and a calibrated bioelectrical impedance balance (Tanita TBF 300) was used to determine body mass and to estimate the percentage of body fat (BF%).

### *Standing Long Jump (SLJ)*

Players performed the SLJ starting from a standing position. They commenced the jump by swinging their arms and bending their knees to provide maximal forward drive. A take-off line was drawn on the ground, positioned immediately adjacent to a jump area. The jump-length measurement was determined using a metric tape measure from the take-off line to the nearest point of landing contact (i.e., back of the heels). Each athlete executed 3 attempts, and the longest distance was considered (10).

**Table 1.** Tabata Training program for a week

| | 1st day | 2nd day | 3rd day |
|---|---|---|---|
| 1 | Push-ups | Mountain Climber | Sit-ups |
| 2 | Squat | Spider Curl | Push-ups |
| 3 | Plank | Crunches | Side Plank(left) |
| 4 | Burpee | Deadlift | Side Plank(right) |
| 5 | Biceps curl | Plank Jack | Jumping Squat |
| 6 | Skipping rope | Biceps Curls | High Knees |
| 7 | Shoulder Press | Bulgarian Lunges(left) | Leg Lift |
| 8 | Sit-ups | Bulgarian Lunges(right) | Jumping Lunge |

*Back strength (BT)*

Subjects stood on the foot-plate of the Takei Back and Leg dynamometer (Takei Scientific Instruments), initially in the same manner as for the measurement of leg strength. The legs were, this time, kept straight and the back was flexed at the hip. Flexion continued until, with fully extended elbows, the tips of the index fingers reached the patellae. The pull-bar of the dynamometer was then placed in the hands and the chain length was adjusted. A reverse grip was adopted for the measurement of back strength to deter the use of shoulder muscles during the 'pull'. Subjects were also instructed to keep the head up during measurement. The highest score from three pulls was recorded.

*Leg strength (LT)*

Subjects, wearing training shots, stood on the foot-plate of the Takei Back and Leg dynamometer (Takei Scientific Instruments) with the scapulae and buttocks positioned flat against a wall. The back of the foot-plate was approximately 15 cm from the wall. Subjects flexed the legs, sliding down the wall until the leg extension angle equalled 135°. Subjects then reached down with the elbows fully extended. The pull-bar of the dynamometer was placed in the hands and the chain length was adjusted appropriately. Subjects were instructed to extend the legs with maximal effort, pulling the bar simultaneously without 'jerking'. The highest score from the three was recorded.

*Zigzag agility test (ZAT)*

The subjects performed zigzag agility tests 3 times on a synthetic grass pitch. There was a recovery period of 3 minutes between trials. The shortest time was recorded as zigzag agility tests. The zigzag agility tests course consisting of four 5-m sections set out at 100° angles (11). Time was measured using a stopwatch.

*Statistical Analysis*

The mean and standard deviation of the data obtained in the descriptive test and performance test measurements of the participants were calculated. The homogeneity test of the data belonging to the pre-test and post-test measurements was performed for both groups. The pre-test and post-test means of the groups were compared with the paired-sample t-test. All statistics were performed in SPSS for Windows, version 22.0 (SPSS, Inc., Chicago, IL). Significance was accepted at $p<.05$ for all statistical tests. Effect size (Cohen's d) was calculated to determine the practical difference between variables. Effect size values of .0-.19, .20-.49, .50-.79, and .80 and above were considered to represent trivial, small, medium, and large differences, respectively (12).

## Results

A significant difference was found between the SLJ ($t=-2.39$; $p=.044$), BS ($t=-5.50$; $p=.001$), and LS ($t=-3.33$; $p=.010$) pre-test and post-test mean scores

of the experimental group. At the end of 8 weeks of TT, a significant increase was observed in these 3 motoric abilities of the experimental group. The difference between the mean BF%, SRT, FBT and ZAT of EG was not significant (p>.05). In the control group, the difference between the pre-test and post-test mean scores of all motoric abilities was not significant except for BS (t=-3.40; p=.009). (Table 2). The effect sizes of the pre-test post-test changes of the variables for EG; BF% (d=.07), SRT (d=.05) and FBT (d=.17) trivial, LS (d=.48) and ZAT (d=.43) small and SLJ (d=.54) and BS (d=.70) were moderate.

## Discussion and Conclusion

The importance of High Intensity Interval Training (HIIT) has been revealed by scientific studies recently. Training methods in addition to regular training times provide important contributions to the performance of athletes, such as plyometric training (13), HIIT (9, 14), core training (15), Tabata training (16-18) and concurrent training (19, 20).

The present study revealed that Tabata Training improved the strength and explosive power abilities of the experimental group. The significant change in the leg, back strength and standing long jump distance showed that this additional training method, which affects the strength characteristics of the players, is effective for improving these motor abilities. Although he developed motor skills such as flexibility, balance, and agility, this development was not at a significant level.

Some previous studies addressing variables different from the motor skills selected in the present study: Saravanan and Sugumar (21) revealed that Tabata training improves the speed, speed endurance and agility of student athletes. Although the significant improvement in agility ability as a result of this study seems to be different from the result of our study, we see that there is an improvement in the agility ability of the experimental group in our study, although it is not significant. Ajayaghosh (8) reported that twelve-week Tabata training of young adult male football players improved their speed and speed endurance abilities.

Similar to the present study results, it was revealed in some previous studies (17) that Tabata training sessions did not provide a significant improvement in the balance and flexibility abilities of the athletes. These high-intensity exercises contribute to the development of motor skills such as strength and speed.

In addition to the chronic effect studies that Tabata training improves aerobic and anaerobic metabolism

**Table 2.** Descriptive and comparative analysis of tests before and after Tabata Training

| Variable | Test | EG (n=9) | | | | | CG (n=9) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Sd | t | p | ES(d) | Mean | Sd | t | p | ES (d) |
| **BF%** | pre-test | 21.51 | 1.62 | .34 | .741 | .07 trivial | 21.63 | 2.02 | .97 | .358 | .18 trivial |
| | post-test | 21.40 | 1.60 | | | | 21.30 | 1.71 | | | |
| **SLJ (cm)** | pre-test | 228.56 | 2.79 | **-2.39*** | .044 | .54 medium | 239.22 | 4.02 | -1.28 | .237 | .24 small |
| | post-test | 230.00 | 3.39 | | | | 240.11 | 3.26 | | | |
| **SRT (cm)** | pre-test | 25.78 | 6.78 | -1.00 | .347 | .05 trivial | 28.67 | 4.80 | -1.67 | .133 | .17 trivial |
| | post-test | 26.11 | 6.47 | | | | 29.44 | 4.16 | | | |
| **FBT** | pre-test | 1.22 | 0.67 | .43 | .681 | .17 trivial | 1.00 | 0.71 | .69 | .512 | .37 medium |
| | post-test | 1.11 | 0.60 | | | | 0.78 | 0.44 | | | |
| **BS (kg.m)** | pre-test | 96.56 | 4.39 | **-5.50**** | .001 | .70 medium | 98.44 | 4.50 | **-3.40**** | .009 | .49 small |
| | post-test | 100.22 | 5.91 | | | | 100.78 | 5.07 | | | |
| **LS (kg.m)** | pre-test | 100.00 | 4.72 | **-3.33*** | .010 | .48 small | 100.56 | 3.68 | -1.65 | .137 | .66 medium |
| | post-test | 102.00 | 3.64 | | | | 103.22 | 4.38 | | | |
| **ZAT (s)** | pre-test | 5.75 | 0.36 | 2.15 | .063 | .43 small | 5.72 | 0.34 | 1.18 | .273 | .30 small |
| | post-test | 5.61 | 0.28 | | | | 5.63 | 0.25 | | | |

(22) and also provides the development of some motoric abilities, studies on the acute effect have also been carried out. Responses for all variables increased in a stepwise fashion with each successive segment of Tabata. Emberts, et al. (23) reported increasingly significant differences for heart rate, estimated $VO_2$, ratings of perceived exertion, and blood lactate accumulation variables during 4-segment Tabata exercises, each lasting 4 minutes.

As a result, Tabata exercises, which is a type of high-intensity interval training, provide significant improvement especially in strength abilities when soccer players apply in addition to their regular training. It would be beneficial for coaches and athletes to do such exercises at the appropriate time for each workout.

**Conflict of Interests:** The authors declare no conflict of interest

**Acknowledgements:** This study was presented as an oral summary presentation at the 2nd World Sports Sciences Research Congress, 21-24 March 2019, Manisa/Turkey.

## References

1. Weston KS, Wisløff U, Coombes JS. High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis. Br J Sports Med 2014; 48(16):1227-34. doi: 10.1136/bjsports-2013-092576.
2. Fox EL, Bartels RL, Billings CE, O'Brien R, Bason R, Mathews DK. Frequency and duration of interval training programs and changes in aerobic power. J App Physiol 1975; 38:481–484. doi: 10.1152/jappl.1975.38.3.481.
3. Tabata I, Nishimura K, Kouzaki M, Hirai Y, Ogita F, Miyachi M, Yamamoto K. Effects of moderate intensity-endurance and high intensity-intermittent training on anaerobic capacity and $VO_{2max}$. Med Sci Sports Exerc 1996; 28:1327-30. doi: 10.1097/00005768-199610000-00018.
4. Viana, RB, De Lira, CAB, Naves, JPA, Coswig, VS, Del Vecchio, FB, Gentil, P. Tabata protocol: a review of its application, variations and outcomes. Clin Physiol Funct Imaging 2019; 39(1): 1-8. doi: 10.1111/cpf.12513.
5. Setiawan, E, Iwandana, DT, Festiawan, R, Bapista, C. Improving handball athletes' physical fitness components through Tabata training during the outbreak of Covıd-19. Jurnal Sportif: Jurnal Penelitian Pembelajaran 2020; 6(2): 375-89. doi: 10.29407/js_unpgri.v6i2.14347.
6. Nithin, M., Sundar, K., KS, M. S., Babu, P. Effect of Tabata training on agility and speed among hockey players. Mukt Shabd Journal 2020; 9(7): 1209-13. doi:09.0014.MSJ.2020.V9I7.0086781.10613.
7. Somade, OA, Nikam, PP. Effect of Tabata Protocol on Exertion Level and Lower Limb Explosive Strength in Recreational Footballers: An Experimental Study. Indian Journal of Public Health Research & Development 2020; 11(4). doi: https://doi.org/10.37506/ijphrd.v11i4.4571.
8. Ajayaghosh, MV. Upshot of Tabata sprint training on selected speed parameters among men football players. International Journal of Yoga, Physiotherapy and Physical Education 2017; 2(6): 33-36.
9. Dupont, G, Akakpo, K, Berthoin, S. The effect of in-season, high-intensity interval training in soccer players. J Strength Cond Res 2004; 18(3): 584-9. doi: 10.1519/1533-4287(2004) 18<584:TEOIHI>2.0.CO;2.
10. Loturco, I, Pereira, LA, Abad, CCC., D'Angelo, RA, Fernandes, V, Kitamura, K, Kobal, R, Nakamura, FY. Vertical and horizontal jump tests are strongly associated with competitive performance in 100-m dash events. J Strength Cond Res 2015; 29(7): 1966-71. doi: 10.1519/JSC.0000000000000849.
11. Mirkov, D, Nedeljkovic, A, Kukolj, M, Ugarkovic, D, Jaric, S. Evaluation of the reliability of soccer-specific field tests. J Strength Cond Res 2008; 22(4): 1046-50. doi: 10.1519/JSC.0b013e31816eb4af.
12. Cohen, J. 1988. Statistical Power Analysis for the Behavioral Sciences. Hillsdale, NJ: Erlbaum Associates. 567.
13. Ramirez-Campillo, R, Alvarez, C, Gentil, P, Loturco, I, Sanchez-Sanchez, J, Izquierdo, M, Moran, J, Nakamura, FY, Chaabene, H, and Granacher, U. Sequencing effects of plyometric training applied before or after regular soccer training on measures of physical fitness in young players. J Strength Cond Res 2020; 34(7): 1959–66. doi: 10.1519/JSC.0000000000002525.
14. Foster C, Farland CV, Guidotti F, Harbin M, Roberts B, Schuette J, Tuuri A, Doberstein ST, Porcari JP. The effects of high-intensity interval training vs steady state training on aerobic and anaerobic capacity. J Sports Sci Med 2015; 14:747-55. PMCID: PMC4657417.
15. Turna, B. The Effects of 6-Week Core Training on Selected Biomotor Abilities in Soccer Players. Journal of Education and Learning 2020; 9(1): 99-109. doi: 10.5539/jel.v9n1p99
16. Olson, M. Tabata interval exercise: energy expenditure and post-exercise responses. Med Sci Sports Exerc 2013; 45: 420.
17. Afyon, YA, Mülazimoğlu, O, Altun, M. The effect of 6 weekly Tabata training on some physical and motor characteristics on female volleyball players. European Journal of Physical Education and Sport Science 2018a; 5(2): 223-9. doi: 10.5281/zenodo.2526321.
18. Afyon, YA, Mülazımoğlu, O, Boyacı, A, İskender, B. Investigation of the effect of Tabata training on vital capacities of swimmers. European Journal of Physical Education and Sport Science 2018b; 5(2): 92-99. doi: 10.5281/zenodo.1867713

19. Adlof L, Cosio-Lima L, Crawley A, Lee Y. The effects of concurrent training on female soccer players. Sport Exerc Med Open J. 2018; 4(1): 16-23. doi: 10.17140/SEMOJ-4-156.
20. Wong PL, Chaouachi A, Chamari K, Dellal A, Wisloff U. Effect of preseason concurrent muscular strength and high-intensity interval training in professional soccer players. J Strength Cond Res. 2010; 24(3): 653-660. doi: 10.1519/JSC.0b013e3181aa36a2.
21. Saravanan, R, Sugumar C. Effect of Tabata interval methods of various durations on speed agility and speed endurance of school students. International Journal in Physical & Applied Sciences 2016; 3(8): 90-96.
22. Tabata, I. Tabata training: one of the most energetically effective high-intensity intermittent training methods. The Journal of Physiological Sciences 2019; 69(4): 559-72. doi: 10.1007/s12576-019-00676-7.
23. Emberts, T, Porcari, J, Dobers-Tein, S, Steffen, J, Foster, C. Exercise intensity and energy expenditure of a tabata workout. J. Sports Sci. Med. 2013; 12(3): 612. PMID: 24137082.

**Correspondence**
Olcay Mulazimoglu
Mugla Sitki Kocman University, Faculty of Sport Science, Mugla, Turkey.
Email: olcaymulazimoglu@mu.edu.tr