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TABATA TRAINING ON IMPROVING PHYSICAL FITNESS (VO_2MAX, MUSCLE FITNESS, AND BODY COMPOSITION) OF FEMALE FUTSAL ATHLETES

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Abstract
This study aims to examine the effects of Tabata Training on improving athletes' physical fitness, assessed through VO_2max, muscular fitness, and body composition. A quasi-experimental method with a one-group pretest-posttest design was employed. The subjects consisted of 20 athletes futsal female aged 18 to 23 years who participated in a six-week training program. Data were analyzed using statistical tests to determine differences between pre- and post-intervention measurements. The results indicated that Tabata Training had a significant effect on increasing VO_2max, muscular strength and endurance, as well as reducing body fat percentage. In conclusion, Tabata Training can be considered an effective method for enhancing athletes' overall physical fitness.
Keywords: *Tabata Training; Physical Fitness; Vo_2Max; Muscle Fitness; Body Composition; Futsal*

INTODUCTION

Physical fitness is a fundamental aspect that critically determines athletic performance across various sports disciplines. Athletes with optimal levels of physical fitness possess superior functional capacity to meet the demands of competition, including the ability to perform high-intensity physical activities repeatedly over prolonged periods (Hita, I. P. A. D. (2024). The primary components of physical fitness include aerobic capacity (VO_2max), muscular fitness (encompassing both strength and endurance), and a balanced body composition between fat mass and fat-free mass (Craig, C. M., Sénéchal, M., McLellan, A. G., Slaght, J., & Bouchard, D. R. (2016). VO_2max reflects the efficiency of the cardiovascular system in transporting and utilizing oxygen during maximal physical exertion (Candra, A. T., & Setiabudi, M. A. (2021). While muscular strength and endurance play essential roles in supporting both explosive and repetitive movements during competition (**Error! Reference source not found.**.

One training approach that has been proven effective in enhancing various aspects of physical fitness is High-Intensity Interval Training (HIIT) (Tya Maya

Ningrum et al., 2023). One of the most popular and rapidly growing forms of HIIT is Tabata Training. One training approach that has been proven effective in enhancing various aspects of physical fitness is High-Intensity Interval Training (HIIT). One of the most popular and rapidly growing forms of HIIT is Tabata Training, a method characterized by a 20:10 second work-to-rest ratio performed repeatedly over a 4-minute set. This protocol was developed by Dr. Izumi Tabata and his colleagues (Taufik et al., 2021). This protocol was developed by Dr. Izumi Tabata and his colleagues, who demonstrated in their study that the Tabata protocol significantly improved both aerobic and anaerobic capacity within a relatively short period of time (Maretno & Arisman, 2020). In addition to its effects on aerobic and anaerobic capacity, recent studies have also shown that Tabata training not only enhances VO_2max but contributes positively to body composition by reducing fat mass and increasing lean muscle mass (Maftukhan, A., & Junaidi, S. (2020).

In addition, Tabata Training is considered time-efficient, making it a relevant strategy for both athletes and coaches in designing training programs that are short in duration yet still provide an optimal physiological stimulus. The study by (Handayani, H. Y., Anwar, K., & Septyaningrum. (2022) Tabata training has also been demonstrated to enhance muscular endurance and decrease body fat percentage among adolescent athletes. The study conducted by (Wahyudi, R., Mujriah, M., & Bausad, A. A. (2023) further revealed that a six-week Tabata training intervention led to significant and efficient improvements in aerobic capacity (VO_2max) among amateur football players of Linggar FC.

Although Tabata Training has been recognized for its potential benefits, comprehensive studies investigating its effectiveness on physical fitness in athletic populations are still limited especially those that evaluate its impact on VO_2max, muscular fitness, and body composition within a single intervention framework. Accordingly, the present study aims to examine the effects of Tabata Training on these three key components of physical fitness (Arisman & Noviarini, 2021).

METHOD

This study employed a quantitative approach using a quasi-experimental design, specifically the One Group Pretest-Posttest Design. This design allows for the measurement of changes or effects that occur after an intervention by comparing pretest and posttest results within the same group (Putra et al., 2020).

The population in this study consisted of athletes from futsal female team Tuban Regancy. The sample was selected using purposive sampling based on the following inclusion criteria: a). Aged between 18 and 23 years, b). Free from injury or medical issues in the past 3 months. c). Moderate fitness level based on baseline VO_2max results, d). Willing to participate in the training program consistently for six weeks. A total of 20 male athletes met the criteria and participated in the study.

The Tabata training program was conducted over a 6-week period, with a frequency of 3 sessions per week (Monday, Wednesday, Friday). Each session lasted approximately 30 to 40 minutes, structured as follows: Warm-up (10 minutes): Light jogging and dynamic stretching.

Main Tabata Session (20 minutes): Composed of 4 to 6 Tabata cycles, each consisting of: 8 sets: 20 seconds of high-intensity exercise followed by 10 seconds of rest, Exercises included: Burpees, Jump Squats, Mountain Climbers, Push-Ups, Plank Jumps, High Knees, Intensity maintained at 80–90% of HRmax, monitored using a heart rate monitor, Cool-down (10 minutes): Static stretching and breathing exercises.

Each session was supervised by certified trainers and the research team to ensure proper technique, adherence to the time ratio, and participant safety.

Table 1. Instruments and Data Collection Techniques

Fitness Component	Test/Method Used	Purpose of Measurement
VO_2max	Multistage Fitness Test (Beep Test)	To measure maximal aerobic capacity
Muscular Fitness	1-Minute Push-Up and Sit-Up Tests	To assess upper body and core muscular endurance
Body Composition	Digital Body Fat Scale + Skinfold Caliper	To measure body fat percentage and lean muscle mass

The Beep Test was used to estimate VO_2max based on the level and number of completed shuttles. Push-Up and Sit-Up Tests were used to measure muscular

strength and endurance functionally. Body composition was analyzed using a combination of a digital scale and skinfold measurements (triceps, suprailiac, and thigh sites) using a caliper.

Data Analysis Techniques. The data from pretest and posttest were analyzed using the following statistical procedures a) Descriptive Data of Participants b) Normality test: Shapiro-Wilk test to assess data distribution. c). Uji hipotesis: Paired Sample t-Test was used to evaluate significant differences between pretest and posttest results (significance level $\alpha = 0.05$). All statistical analyses were performed using SPSS version 23.

RESULT

The descriptive analysis was conducted to present the mean and standard deviation values of each measured physical fitness variable both before and after the Tabata Training intervention.

Table 2. Descriptive Statistics of Pretest and Posttest Results (N = 20)

Variable	Pretest (Mean ± SD)	Posttest (Mean ± SD)
VO_2max (ml/kg/min)	42.10 ± 3.54	46.85 ± 3.21
Push-Up (reps)	27.30 ± 4.10	35.60 ± 4.42
Sit-Up (reps)	29.80 ± 3.94	38.25 ± 3.98
Body Fat (%)	19.75 ± 2.48	17.22 ± 2.15

The results indicate that all variables improved after the 6-week Tabata Training program. VO_2max increased by approximately 4.75 ml/kg/min, the number of push-ups increased by 8.3 repetitions, sit-ups increased by 8.45 repetitions, and body fat percentage decreased by 2.53%.

Normality Test

The Shapiro-Wilk test was used to determine whether the data followed a normal distribution. Based on Table 2, all significance values are greater than 0.05, indicating that the data for each variable are normally distributed. Therefore, further analysis using the paired sample t-test is appropriate.

Table 3. Shapiro-Wilk Normality Test Results

Variable	Shapiro-Wilk Sig. (Pretest)	Shapiro-Wilk Sig. (Posttest)
VO_2max	0.256	0.198
Push-Up	0.133	0.169

Sit-Up	0.240	0.172
Body Fat (%)	0.087	0.142

Negative mean difference for VO_2max, Push-Up, Sit-Up indicates increase; positive for body fat indicates decrease.

Paired Sample t-Test

To examine the significance of the differences between the pretest and posttest, the paired sample t-test was conducted.

Table 4. Paired Sample t-Test Results

Variable	t-value	Sig. (2-tailed)	Mean Difference
VO_2max	-9.382	0.000	-4.75
Push-Up	-10.225	0.000	-8.30
Sit-Up	-10.801	0.000	-8.45
Body Fat (%)	7.012	0.000	2.53

The results from the paired sample t-test show that all variables experienced statistically significant changes after the intervention. The p-values for all variables were less than 0.001, which means Tabata Training had a significant effect on improving VO_2max, muscular endurance (push-up and sit-up), and reducing body fat percentage.

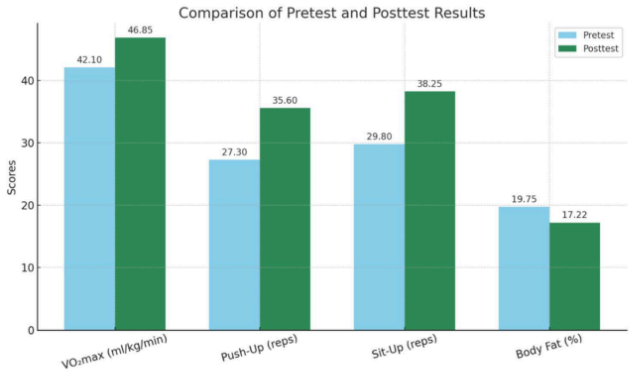

Figure 1. Comparison of Pretest and Posttest Results

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As shown in Figure 1, there is a consistent improvement across all physical fitness indicators following the six-week Tabata Training intervention. VO_2max and muscular fitness variables (push-up and sit-up) increased markedly, while body fat percentage showed a noticeable decline. This visualization supports the numerical findings, reinforcing the positive effect of Tabata Training on athletes' physical fitness.

DISCUSSION

This study demonstrates that Tabata Training has a statistically significant effect on improving multiple components of physical fitness in athletes, including VO_2max, muscular fitness (push-ups and sit-ups), and body composition (body fat percentage). The increase in VO_2max (mean difference = +4.75 ml/kg/min) indicates enhanced aerobic capacity, which is vital for athletic endurance and recovery. The increase in VO_2max (mean difference = +4.75 ml/kg/min) indicates enhanced aerobic capacity, which is vital for athletic endurance and recovery. These findings are consistent with (Tabata, I., Nishimura, K., Kouzaki, M., Hirai, Y., Ogita, F., Miyachi, M., & Yamamoto, K. (1996). Who found that high-intensity interval training (HIIT) improves both aerobic and anaerobic systems. The marked improvement in muscular endurance (mean increase: push-ups +8.30 reps; sit-ups +8.45 reps) suggests that the structured and repeated bouts of high-intensity effort in Tabata cycles effectively stimulate muscular adaptation. These adaptations may include increased neuromuscular coordination, muscle fiber recruitment, and local muscular endurance.

Furthermore, the decrease in body fat percentage (mean reduction: -2.53%) indicates the effectiveness of Tabata Training in altering body composition. The high-intensity nature of the workout contributes to greater post-exercise oxygen consumption (EPOC), which enhances fat metabolism even after the training session has ended.

Although the findings are promising, several limitations should be acknowledged; Absence of a control group limits the ability to attribute

improvements solely to the Tabata intervention without accounting for potential confounding variables such as diet or additional training outside the program. The accuracy of body composition measurements using a digital scale and calipers may be less precise than advanced imaging techniques like DEXA.

This study contributes to the growing body of evidence supporting high-intensity interval training by specifically examining Tabata training as a structured protocol and its simultaneous effects on VO_2max, muscular endurance, and body composition. Unlike previous studies that focused on general fitness populations or isolated performance variables, this study offers a simultaneous assessment of the effectiveness of Tabata training on aerobic capacity (VO_2max), muscular strength, and muscle fat status. This study integrates multiple fitness domains and applies the protocol in a sport-specific context for competitive athletes. Moreover, the use of Tabata in a short time-efficient protocol (20–30 minutes per session) provides practical value for athletic training programs that require efficiency without compromising effectiveness.

Based on the results and limitations of this study, several suggestions can be made for future research. First, future studies should use a control group to better compare the effects of Tabata Training and to ensure that the improvements are truly caused by the training program. A randomized controlled trial (RCT) design would give stronger and more reliable results.

Second, the training period can be extended to 8 to 12 weeks to see more long-term effects, especially on aerobic capacity, muscular strength, and body fat reduction. Third, future research should involve a more diverse group of participants, including female athletes, different age groups, and athletes with various levels of physical fitness. This will help to understand whether the effects of Tabata Training are similar across different populations.

Fourth, it is recommended to use more accurate tools to measure body composition, such as DEXA scans or bioelectrical impedance devices, for better precision in measuring fat and muscle mass.

Finally, researchers should explore how Tabata Training affects specific sports performance, such as sprint speed, agility, or recovery time. This will help

coaches and athletes apply Tabata Training more effectively in real sports situations.

By following these suggestions, future studies can give deeper insights into the benefits and applications of Tabata Training for athletes.

CONCLUSION

This study concludes that Tabata Training has a significant and positive effect on various components of physical fitness in athletes. After six weeks of regular training, participants showed marked improvements in VO_2max**,** indicating better aerobic capacity, and in muscular fitness, shown through increased push-up and sit-up performance. Additionally, there was a notable reduction in body fat percentage, suggesting improved body composition.

These findings confirm that Tabata Training, as a form of high-intensity interval training (HIIT), can be an effective and time-efficient method for improving overall physical fitness. It is especially useful for athletes who need to enhance both cardiovascular endurance and muscular endurance within a short training period.

Overall, Tabata Training can be recommended as part of a structured training program for athletes. However, further studies with larger and more diverse samples, longer intervention periods, and advanced measurement tools are needed to support and expand upon these results.

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