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Meningkatkan komponen kebugaran jasmani atlet bola tangan melalui latihan Tabata pada saat terjadinya wabah COVID-19

Improving handball athletes' physical fitness components through Tabata training during the outbreak of COVID-19

Edi Setiawan[1], Dody Tri Iwandana[2], Rifqi Festiawan[3], and Ceu Baptista[4]

[1]Department of Physical Education, Universitas Suryakancana, Street of Pasirgede Raya, Cianjur Regency, West Java Province, 43216, Indonesia
[2]Sports Science Study Program, Universitas Mercu Buana, Sedayu, Bantul, Special Region of Yogyakarta, 55752, Indonesia
[3]Departement of Physical Education, Universitas Jenderal Soedirman North Purwokerto, Banyumas Regency, Central Java Province, 53112, Indonesia
[4]Department of Sport Science, National University of Timor Lorosa'e, Timor Leste

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Abstrak

Tujuan dari penelitian ini adalah untuk meningkatkan kebugaran fisik atlet melalui pelatihan Tabata. Metode penelitian yang digunakan adalah pra-eksperimen dengan *One Group Pretest-Posttest Design*. Peserta dalam penelitian ini adalah atlet bola tangan pria (N = 30) (usia = 21,8 ± 1,3 tahun, tinggi = 169,6 ± 2 cm, berat = 60,7 ± 7 kg), semua peserta melakukan pelatihan Tabata selama 23 sesi dengan frekuensi 3 seminggu sekali. Tingkat kebugaran fisik atlet diukur menggunakan *push up*, *curl up*, *V-sit and reach* dan peregangan bahu. Semua data dianalisis menggunakan SPSS dengan tingkat signifikansi 0,05. Hasil penelitian ini menemukan bahwa komponen kebugaran fisik, yaitu kekuatan daya tahan (P <0,05), kekuatan otot (P> 0,251), mobilitas di daerah punggung bawah dan paha belakang (P <0,05) dan mobilitas lengan atas (P <0,05) mengalami perbedaan sebelum dan sesudah intervensi program pelatihan Tabata. Studi ini menyimpulkan bahwa dalam situasi wabah *coronavirus* saat ini di seluruh dunia, Tabata adalah pelatihan alternatif yang dapat dilakukan oleh atlet bola tangan individu di rumah dan metode Latihan Tabata memiliki manfaat untuk meningkatkan beberapa komponen kebugaran fisik atlet bola tangan.

Kata kunci: bola tangan, COVID-19, kebugaran fisik, latihan Tabata.

Abstract

The purpose of this research was to improve the handball athletes' physical fitness through Tabata training during the outbreak of COVID-19. This pre-experimental research used a One-Group Pretest-Posttest Design. The research participants were male handball athletes at amateur level (N = 30) (age = 21.8 ± 1.3 years, height = 169.6 ± 2 cm, weight = 60.7 ± 7 kg). All participants performed the Tabata training for 23 sessions with a frequency of 3 times a week. The athletes' physical fitness level was measured using push-ups, curl-ups, V-sit and reach, as well as shoulder stretch. All research data were then analyzed using SPSS version 22 with a significance level of α 0.05. The results of this research found that the physical fitness components consisting of strength endurance (P<0.05), muscle strength (P>0.251), flexibility in the area of lower back and hamstrings (P<0.05) as well as upper arm flexibility (P<0.05)

Correspondence author: Edi Setiawan, Universitas Suryakencana, Indonesia.
Email: *edisetiawan@student.upi.edu*

experienced differences before and after performing the Tabata training program. It is concluded that in response to the outbreak of COVID-19 throughout the world, Tabata is one alternative training to be performed by each handball athlete at home since Tabata training may provide various benefits in improving the handball atlethes' physical fitness components.

Keywords: *COVID-19. handball, physical fitness, Tabata training.*

INTRODUCTION

Handball is a team sport with a high intensity game characteristic in both defense and attack. In addition, handball game has many movements, such as sprint, turning, throwing, blocking, pushing, grabbing, and jumping (Karcher & Buchheit, 2014; Iacono, Eliakim, & Meckel, 2015; Alonso-Fernández, Lima-Correa, Gutierrez-Sánchez, & Abadía-García de Vicuña, 2017; Ortega-becarra, Pareja-Blanco, Jiménez-Reyes, Cuadrado-Peñafiel, González-Badillo, 2018). Those movements may be optimized during the training and competition sessions, if the handball athletes have high physical fitness levels.

Physical fitness is one most important aspect showing both young and adult athletes' health conditions (Ortega-becarra, Pareja-Blanco, Jiménez-Reyes, Cuadrado-Peñafiel, González-Badillo, 2018). Thus, in the last decade, several countries have promoted increasing the young athletes' physical fitness (Vega, Viciana, & Cocca, 2013). Physical fitness is defined as a set of attributes related to someone's ability to perform physical activities, such as cardiorespiratory endurance, strength, flexibility, speed, and power (Kyung Lee**,** Kyu Kim, & Jeon, 2018). All physical fitness components are greatly important for the handball athletes to possibly exercise over a relatively long period without feeling excessive fatigue and support their performance when joining a competition (Granados *et al.*, 2013). However, one most frequently arising problem is related to the decreasing physical fitness during the detraining period (Vassilis *et al.,* 2019). Some studies have reported the decreasing physical fitness after 8 to 12 weeks of inactivity (Lee Ingle, Sleap & Tolfrey, 2006). Most countries throughout the world are facing the COVID-19 pandemic situations that improving physical fitness is not an easy task. If the

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athletes' physical fitness is continuously ignored or not well trained, it will influence their performance when joining a competition.

COVID-19 first appeared in Wuhan, China (Nishiura, Lintona & Akhmetzhanova., 2020). Although most countries throughout the world have made various preventive actions and tried to find the COVID-19 vaccines, the number of deaths and infected people throughout the worldwide continuously increases each day (Chang-Ju Kim., 2020). COVID-19 is a part of family viruses causing diseases in both animals and humans. When infected COVID-19, those people will show various signs of large-scale airway infections, ranging from flu to more serious ones, such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) (Qianying, 2020), pneumonia, and may even result in death. According to a report from Johns Hopkins University, between January 25 and April 6, 2020, of 1,296,000 COVID-19 cases reported throughout the world 272,000 people were recovered and 71,400 people died. However, the outbreak still continues and becomes one major threat to the global public health (Bogoch *et al.*, 2020).

COVID-19 is rapidly and widely spread in Indonesia that more people are infected. The data showed that on between February 14 and April 6, 2020, 2,491 cases were reported, 192 people were recovered, and 209 people died. DKI Jakarta and West Java were the most infected areas in Indonesia (Ministry of Health., 2020). The impacts of COVID-19 resulted in social distancing, closed commercial areas and companies as well as primary, secondary and tertiary schools, including universities (Chang-Ju Kim, 2020). All major sports tournaments were suspended or canceled due to the outbreak of COVID-19 (Toresdahl & Asif., 2020), and various joint training activities were also prohibited (Jukic *et al.*, 2020). These measures were performed in preventing from the outbreak of COVID-19 and the worsening scenario. Thus, one best exercise method is greatly required by the athletes to be properly performed anytime and anywhere (e.g., home), such as Tabata training.

Tabata training was discovered in 1996 by Izumi Tabata Ph.D, at

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the Institute of National Sports and Fitness, Tokyo, Japan. Tabata training is defined as a form of training combining the intermittent and high-intensity exercises. Tabata was first created for cycling and other trainings, such as running, weight training (e.g., burpees and squat jumps) (Tabata, 2019). Tabata popularity in several European (e.g., Germany, Netherlands, and Slovakia) and Asia countries (e.g., Japan, Australia, and Indonesia) significantly increased as many trainers have implemented the training. Tabata training has been implemented to improve both aerobic and anaerobic capacities by simultaneously imposing intensive stimuli on both systems (Rebold, Kobak, & Otterstetter, 2013). The benefits of Tabata training include (1) burning calories, (2) increasing body metabolism during exercise, (3) increasing body metabolism after exercise, (4) fit for anyone who has limited time to exercise (5) improving both aerobic and anaerobic systems. Tabata is a four-minute interval training consisting of 8 rounds at a maximum effort of 20 seconds, each followed by 10-second resting time (Sumpena & Sidik, 2017). There are many Tabata studies proposing a three-minute workout with <30-second intervals with a ratio of 1:1, 2:1, 1:2. In addition, other studies implemented Tabata training with the duration of 20-60 minutes (Rýzková, Labudová, Grznár, & Šmída, 2018). Tabata training integrates several movements, such as scissors, squats, push-ups, plank, mountain climbers, and high knees in which each movement is performed at a high-intensity rate. Furthermore, Tabata training is accompanied by an international vibrant music rhythm that the athletes will not get bored easily but feel motivated to repeat the training exercises. Tabata training should not be too frequently performed. It is only recommended once or twice a week, or 3 days in a week (Demirci, Odabaş, Ozgür, & Bayir, 2017).

The results of previous studies reported that Tabata training was less pleasant or eliminated the exercising pleasures (Foster *et al.*, 2015; Scott, Beliveau, Desmond, & Rollins., 2016). Other studies also reported that Tabata was rarely used to improve the physical conditions, and some trainers did not know the benefits and still doubted the effectiveness of

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Tabata training (Imanudin & Sultoni, 2017). Thus, the purpose this study is to assess the effectiveness of Tabata training in improving some physical fitness components during the outbreak of COVID-19.

METHOD

Research design

This research used a pre-experimental method with one-group pretest-posttest design. This design only used one group to observe (experimental group) and had no comparison (control group).

Participants

The research participants were male handball athletes at amateur level (n = 30, age = 21.8 ± 1.3 years, height = 169.6 ± 2 cm, weight = 60.7 ± 7 kg). All participants lived in Cianjur Regency, West Java, Indonesia and agreed to participate in this research. In addition, this research was supported by two handball trainers assisting the researchers conducting the research activities.

Training protocol

Tabata training was performed 3 times a week on Tuesdays, Thursdays and Saturdays. The participants performed the Tabata training at home, starting at 8 a.m. All 30 participants did the warm-up exercises (e.g. proprioceptive neuromuscular facilitation (PNF) and jogging) before starting the Tabata training. The participants then performed the Tabata training consisting of 20 seconds for one exercise with 10-second intervals (e.g., squats for 20 seconds, and resting for 10 seconds; jumping jack for 20 seconds, and rest 10 seconds, and so on). This cycle was repeated for 2-3 sets, in 4-minute-workouts. Before completing the Tabata training, all participants performed the cool-down exercises. Table 1 shows further details related to the Tabata training programs.

Table 1. Daily Tabata Training Programs

Training components	Training activities	Duration
Warm-up	Proprioceptive neuromuscular facilitation (PNF) and jogging	3 min
Focus on practice	Tabata workouts for 2-3 sets in 20second high intensity training by 80-90% (e.g., squat,	7 min

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Continued Table 1. Daily Tabata Training Programs

	jumping jack, plank, burpees, and mt. climber), and 10-second resting	
Cool-down	Stretching	3 min

Procedures

This research has met the Ethical Code of the World Medical Association (Declaration of Helsinki) (Shrestha, 2012). This research was conducted in 3 months, from January to March, 2020 (23 meetings). This research was conducted to the research participants in their respective places. To ensure that the participants had performed the intervention programs in accordance with the training protocol, the researchers used zoom videos to monitor the participants' activities. In session 1, all participants did the physical fitness pre-test. In sessions 2, the participants performed the treatments (Tabata training) until session 22. Finally, in session 23, all participants did the physical fitness post-test. Table 2 clearly describes the Tabata training programs in this research.

Table 2. Research Programs During 23 Sessions

Session	Date	Description	Duration
1	9 January 2020	Pre-test Physical fitness	Starting at 8 a.m.
2-4	11,13,14 January 2020	○ Warm-up. ○ Tabata workouts for 2 sets with 3 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	10 min 4 min 5 min
5-7	18,20,23 January 2020	○ Warm-up. ○ Tabata workouts for 2 sets with 4 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	10 min 4 min 5 min
8-10	25,27,30 January 2020	○ Warm-up. ○ Tabata workouts of 2 sets 5 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	10 min 4 min 5 min
11-13	1,3,6 February 2020	○ Warm-up. ○ Tabata workouts for 2 sets with 6 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	10 min 4 min 5 min

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Continued Table 2. Research Programs During 23 Sessions

14-16	8,10,13 February 2020	○ Warm-up. ○ Tabata workouts for 2 sets with 7 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	10 min 4 min 5 min
17-19	15,17,20 February 2020	○ Tabata workouts for 2 sets with 7 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	3 min 4 min 5 min
20-22	22,25,27 February 2020	○ Warm-up. ○ Tabata workouts for 3 sets with 7 reps (squat, jumping jack, plank, burpees, and mt. climber). ○ Cool-down.	10 min 4 min 5 min
23	3 March 2020	Post-test Physical fitness	8 a.m. until finish

Instruments

The participants of this research performed the physical fitness tests and measurements adopted from INDARES (Rubin *et al.*, 2017). In the physical fitness module, there were several test batteries, including push-ups, curl-ups, V-sits, as well as reach and shoulder stretches. In INDARES, not all physical fitness components are tested and measured, only a few test items are used, such as strength endurance, muscle strength, and flexibility. The physical fitness test items include:

a. T1: Push-ups

This test is used to measure the upper body strength endurance level. This test requires equipment, such as stopwatch and stationery. During the test activities, the participants should do the warm-up and then push-ups as many as possible or until drop. Scoring is made by calculating and approving the push-ups. This test has the reliability coefficient of 0.60 to 0.98 (Plowman & Meredith., 2013)

b. T2: Curl-ups

This test is used to measure the abdominal muscle strength. This test requires the following equipment: stationery and stopwatch. First, the participants should do the warm-up and then curl-ups for 1 minute

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(Guerra, Rebernisek, Dos & Eduardo, 2019). Scoring is made by counting the curl-ups for 1 minute. This test has the reliability coefficient of 0.64 to 0.94.

c. T3: V-sits and reach

This test is used to measure the joint mobility of lower back and hamstrings. This test requires some equipment, such as: measuring tape and stationery. During the test activities, the participants should do the warm-up then V-sits, and finally reach stretches. Scoring is made by measuring the farthest distance resulted from the sit and reach. This test has the reliability of 0.98 (Roman, Machová, & Lipenská, 2013).

d. T4R and T4L: Shoulder stretch

This test is used to measure the upper arm strength, especially shoulders. This test requires no equipment. Participants should do the warm-up, then, move the right arm up, and the left arm down in standing position, trying to touch the fingertips behind the back (T4R), and vice-versa (T4L). Scoring is made by seeing whether or not the fingers could be touched or reached, given the value of "1" if reached or "0" If not. This test is conducted in 30 seconds and has the reliability of 0.91 (Vanhelst, Béghin, Fardy, Ulmer, & Czaplicki, 2016). Tests and measurements were made by the participants of this research at home, while the researchers supervised their physical fitness test activities via zoom videos.

Statistical analysis

The research data was then analyzed using SPSS (version 22) to describe the athletes' physical characteristics (age, height, and weight). Normality and homogeneity test were conducted using the Shapiro-Wilk and Levene Test. Then, to examine the physical fitness differences before and after the intervention of Tabata training, the paired sample t-tests were conducted with the significance level criteria of P≤0.05 (Abbasi, Nazarali, Hedayati & Alizadeh, 2018).

RESULTS

Table 3 shows the descriptive results of handball athletes' physical characteristics (age, height, and weight). The results of the normality test

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conducted using the Shapiro-Wilk test showed a normal and homogeneous distribution (0.114), while that conducted by the Levene test showed the homogeneous variance (0.513). Table 4 shows the results of physical fitness differences before and after the intervention of Tabata training.

Table 3. Description of handball athletes' physical characteristics

Variables (n=30)	M	±	SD
Age (year)	21.8	±	1.3
Height (cm)	169.6	±	2
Weight (kg)	60.7	±	7

Note: n= Sample; M=Mean; SD=Standard Deviation

Table 4. Comparative Analysis of Handball Athletes' Physical Fitness Pre-Test and Post-Test

Physical Fitness Component Variables	Pre-test n=30			Post-test n=30			P-value
	M	±	SD	M	±	SD	
Push-ups	12.1	±	1.53	13.8	±	1.39	0.000
Curl-ups	11.10	±	1.729	11.67	±	3.198	0.251
V-sits and reach	5.27	±	8.68	6.43	±	8.58	0.000
Shoulder stretch	3.67	±	7.58	4.90	±	7.59	0.000

Note: n= Sample; M=Mean; SD=Standard deviation

Table 4 shows that there were some result differences before and after the intervention of Tabata training in all physical fitness components: strength endurance (push-ups) ($P< 0.05$) significantly increased, muscle strength (curl-ups) ($P> 0.05$) did not significantly increase, flexibility in the area of lower back and hamstrings (v-sits and reach) ($P< 0.05$) and flexibility of upper arm (shoulder stretch) ($P< 0.05$) significantly increased.

DISCUSSION

Based on the results of this research, the researchers found that there was a positive improvement related to the handball athletes' physical fitness components.

The influence of Tabata training for strength endurance

Tabata training is designed with the concept of 2-1, exercising for 20-second rounds at maximum intensity (80-90% of maximum heart rate) and resting for 10 seconds between each round is an effective way to

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improve the physical fitness component of strength endurance. The results of this research found that before the intervention of Tabata training, the participants were only able to do squat, jumping jack, plank, burpees and mt. climber ranging from 1 set with 3 reps in 4 minutes, but after the intervention of Tabata training, the participants were able to do squat, jumping jack, plank, burpees and mt. climber ranging from 3 sets with 7 reps in 4 minutes. The other studies found that the increasing anaerobic lactate (90%) was influenced by the Tabata training, while the other 10% was influenced by the other factors. In addition, 66.3% of agility endurance, 87.3% of power endurance, and 82.2% of speed endurance were affected by the Tabata training (Sumpena & Sidik, 2017). The increasing strength endurance in this research was due to the high exercise intensity and repetition frequency during the training sessions.

The influence of Tabata training for muscle strength

Muscle strength is a physical fitness component required by the athletes when joining a competition (Akınoğlu & Kocahan, 2018). However, the results of this research indicated that Tabata training did not influence the muscle strength development. These results were similarly shown in the previous studies conducted in Japan related to the body-weight-bearing exercises (e.g., burpees and squat jumps), the published evidence of their metabolic profiles and effects on both VO2max and the maximal accumulated oxygen deficit (MAOD) was insufficient (Tabata, 2019). Thus, muscle strength might not be increased through Tabata training, yet still possible with the combination of resistance training and Tabata training (Tabata, 2019). Other studies reported that there was no significant influence of HIIT/ Tabata training on muscle (ES = 0.106, 95% CI: −0.224 to 0.435; p = 0.529) (Sabag *et al.*, 2018). Further research may be expected to explain this issue.

The influence of Tabata training on flexibility in the area of lower back and hamstrings as well as the upper arm flexibility

The handball athletes' flexibility components in the area of lower back and hamstrings, as well as the upper arm flexibility increased. It was

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consistent with the findings of the previous studies showing that Tabata interval trainings for 8 weeks resulted in the increasing muscle flexibility of hamstrings (Rýzková et al., 2018).

In session 23, the Tabata training program significantly increased strength endurance, flexibility in the area of lower back and hamstrings and upper arm flexibility. The previous researchers also emphasized that Tabata training was a method which possibly improves the fitness components (Batacan, Duncan, Dalbo, Tucker, & Fenning, 2017; Eddolls, McNarry, Stratton, Winn, & Mackintosh, 2017; Martínez-lópez *et al.*, 2018).Thus, the increasing strength endurance, flexibility in the area of lower back and hamstrings, upper arm flexibility in this research was due to the gradually increased exercise intensity and repetition frequency during the training sessions.

Considering the results of this study, it was proven that Tabata training might improve the handball athletes' physical fitness components. The participants stated that they enjoyed doing the Tabata exercises at home without fear of possibly infected by the COVID-19. It is recommended that Tabata training as one effective exercise to improve the participants' physical fitness of any sport, especially handball. The other results of this study suggest that this high-intensity intermittent exercise is greatly effective to improve the sports-related physical fitness (Tabata, 2019). The Tabata training program in this research may be used by the handball trainers to develop the athletes' physical fitness. This research is limited to the low number of participants with no compared group (control group). A future research should be further conducted, such as by comparing the Tabata training with circuit training (Festiawan, Raharja & Raharja, 2020), Zumba, Fartlek or other related trainings.

CONCLUSION

COVID-19 has become a global pandemic and temporary stopped the handball practices and competitions throughout the world. This research concludes that Tabata is one best training which may be individually performed by the handball athletes at home. Tabata training

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also provides various benefits to improve the handball athletes' physical fitness components.

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