PHYSIOLOGICAL CHARACTERISTICS OF MEN'S DOUBLE BADMINTON PLAYERS

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Abstract

Purpose: This study aimed to examine the physiological characteristics of Indonesian Badminton young players and to use the findings to plan training with greater precision.

Subjects and Methods: In this study, 12 male badminton players from Jaya Raya Badminton Club volunteered to be subjects. Body scan composition, Lactate, Heart Rate, VO2max and other respiratory parameters were measured in the laboratory of National Sports Hospital Jakarta with Dexa Scan Body Fat, Accutrend Plus AU Kit, Transmisor Polar H7 Bluetooth, Cardio Pulmonary Exercise Test Treadmill, Lode-Valiant 2, respectively. This study also measures of Lactate, Heart Rate parameters during match simulations were measured in the Badminton Jaya Raya Stadium Jakarta. The technical assessment during match simulations was developed by members of the training team who have more than 10 years of experience in badminton. The laboratory and match simulations tests were separated by at least 7 days.

Results: This study has shown, no significant difference in weight (p=0.83), height (p=0.55), BMI (p=0.76), body fat (p=0.91), VO_{2max} (p=0.82), VE (p=0.26), Rf (p=0.49) was found between each pair of participants. In the lactate measures, significantly different were observed between laboratory and match simulation tests (p=0.001). Furthermore, significant difference in HR was found between tests (p=0.001)

Conclusions: We demonstrated that HR monitoring and lactate concentration during laboratory test is higher than match simulation. Additionally, because of the badminton games is intermittent nature, our results suggest that aerobic high-intensity intervals should preferably be used by coaches and athletes to induce the development of an endurance capacity and VO2max.

Keyword: Measurement**,** Racket sports, Physiological profile, Performance, Sport Science.

Introduction

Badminton is one of the most popular racquet sports in Indonesia [1]. On the fact that in Barcelona when it's an Olympic in 1992, Indonesia and South Korea has reached two gold medals [2]. In case, this is an improvement that Indonesia was able to compete in sports. For this reason, in the process of defending an achievement, physiological examining must be optimized. In the fact, performance in badminton is characterized by intermittent activities of high and low intensity interspersed by short recovery periods [3]. Because of the game's intermittent nature, several studies have been difficult to investigate badminton from an aerobic or an anaerobic perspective alone [4,5]. Furthermore, physiological examining feasibility during on-court activities is limited by the encumbrance of portable metabolic systems, however [6].

Although physiological examining feasibility during on-court activities is limited, some studies have shown that examining the physiological characteristics of badminton players can become a formula for aid in more appropriate planning and monitoring of specific training [7,8,9]. For example, previous research conducted by Cabello et al, explained that badminton is characterised by repetitive efforts of alactic nature and great intensity which are continuously performed throughout the match, thus the results suggested that coaches should therefore base training on a large number of competitive actions of high intensity but short duration. Moreover, they should train specific endurance by means of actions and moves performed at short (15–20 seconds) and very short (6–10 seconds) intervals [7].

We were also interested with previous research conducted by Susanna Rampichini et al, which explained that the difference in HR vs VO_2 regression lines between the laboratory examination (IIAT test) and the on-court condition indicates that HR monitoring may not provide accurate data on the aerobic demands of specific on-court badminton tasks [8]. While these studies show equivocal findings for the physiological characteristics of badminton athletes after laboratory and on-court badminton tasks, the results that can be formula for aid in more appropriate planning and monitoring of specific training are lacking.

Based on these interests, this study aimed to examine the physiological characteristics of Indonesian Badminton young players and to use the findings to plan training with greater precision. We realize that, Indonesia is the country that potential in badminton competition on the world, because that physiological examination for badminton athletes in laboratory or on-court is needed. Furthermore, the findings of this study have expected can adds to the scientific literature that supports the use of physiological characteristics can be used by coaches and sport scientists.

Material and Methods

Participants

12 male badminton players (Mean ± SD; age= 16.50±0.67 years; height= 175.33±5.93 cm; weight = 69.01±7.55 kg; body fat (kg) = 13.02±3.80; VO_{2max} (ml/kg/min^{-1}) = 49.95±4.45; Muscle mass in humerus dextra (kg) = 3.36±0.43; Muscle mass in humerus sinistra (kg) = 2.89±0.52; Muscle mass in trunk dextra (kg) = 11.98±1.16; Muscle mass in trunk sinistra (kg) = 12.43±1.05; Peak VO_2/HR (ml/bpm) = 17.42±2.48) from Jaya Raya Badminton Club provided informed consent to participate in this observational study and the procedures were approved by the ethics committee of the Bandung Health Polytechnic.

Study design

This study requires all participants to completed two experimental sessions separated by a week recovery periods. Participants performed a warm-up (6 min jog at 6.8 km h-1) prior to testing session. During the first session (laboratory condition), the VO_{2max} and lactate concentration was measured using a Cardio Pulmonary Exercise Test Treadmill (Test Treadmill, Lode-Valiant 2) and Accutrend Plus AU Kit, respectively. During the second session (simulation match), the participants played a simulated match on court were played according to the current rules of the Badminton World Federation (BWF).

Laboratory condition

Before undergoing the test, participants were asked to take a light dinner (before 09:00 p.m.) on the day before and not to eat food or drink caffeine beverages on the test day. Monday morning at 09:00 a.m, anthropometric was measured in laboratory. The body weight were measured on Omron Digital Weight Scale HN 289, with participants wearing minimal clothes and being barefoot. The body height was measured with a stadiometer with 0.1cm readability (Seca 214 Portable Stadiometer, Cardinal Health, Ohio, USA). Additionally, body scan composition was measured with Dexa Scan Body Fat according to the described standardised procedures.

After the anthropometric measurements, A 100 µL sample of fingertip capillary blood was obtained to measure lactate. The cardiorespiratory test began at 09:30 a.m. The selected test was a Cardio Pulmonary Exercise Test Treadmill (CPET), providing us with each player's maximum heart rate, minute ventilation, breath frequency and VO_{2max}. The heart rate (HR) was monitored with a test employing a Polar RS400 Finland. After the end of the last task section blood lactate were measured immediately after CPET test. Participants were allowed to drink mineral water ad libitum during the recovery period, but we encouraged to drink enough to maintain hydration. VO_{2max} and anthropometry assessment are shown in Figure 1.

Figure 1. Displays the research evidence of VO_{2max} and anthropometry assessment

Simulation match condition

A week after finished of laboratory condition, simulation match condition was conducted in the Badminton Jaya Raya Stadium Jakarta. All participants lived in the athletes' dormitories and followed the same training sessions during recovery periods. To ensure that athletes were highly motivated, matched were included in regular internal ranking competition. During simulation match, one video camera (Handycam Canon LEGRIA FS200) was mounted 5-m behind the baseline and 4-m above the ground at the same end of each court to film each match. A 100 µL sample of fingertip capillary blood also was obtained to measure lactate pre-match, post-match (immediately after simulation match) and HR was continuously monitored during simulation match with Polar RS400 Finland.

The technical assessment during match simulations was developed by members of the training team who have more than 10 years of experience in badminton. The assessment of match characteristics was adopted and based on previous assessment method [5]. (i) the smash is an aggressive overhead shot with a downward trajectory, (ii) the clear is an overhead shot with a flat (offensive clear) or rising trajectory (defensive clear) towards the back of the opponent's court, (iii) the drop is a smooth shot from above the head with a downward trajectory towards the front of the court, (iv) the net shot is a precise shot from near the net, which includes the net drop, (v) the lob (offensive shot with a flat trajectory towards the back of the opponent's court and defensive shot with a rising trajectory) and the kill (aggressive shot with downward trajectory), (vi) the drive is a powerful shot made at middle body height and in the middle of the court with a flat trajectory, (vii) while a forced error occurred if a player was unable to make a reasonable attempt at playing a shot and the shuttlecock did not land in the opposition court. An unforced error occurred when a participant had adequate time and space to play a shot but missed the court (either outside the lines or into the net). Match characteristics assessment are shown in Figure 2.

Figure 1. Displays the research evidence of simulation matches

Statistical Analysis

One-way repeated measures ANOVA was used to evaluate the weight, height, BMI, body fat, VO_{2max}, VE, Rf on each pair of participants. A 2 (condition tests: laboratory and match simulation) × 2 (time: pre, post) repeated measures analysis of variance (ANOVA) were calculated for lactate concentration of all participants. Independent t-test was used to determine any differences HR among the laboratory and match simulation tests. The values are presented as mean ± SD. Statistical significance was accepted at the $p<0.05$ level.

Results:

The characteristics of the study sample during match simulations are presented in Table 1. Table 2 shows the weight, height, BMI, body fat, VO_{2max}, VE, Rf on each pair of participants. This study has shown, no significant difference in weight ($p=0.83$), height ($p=0.55$), BMI ($p=0.76$), body fat ($p=0.91$), VO_{2max} ($p=0.82$), VE ($p=0.26$), Rf ($p=0.49$) was found between each pair of participants. In the lactate measures, there was a significant main effect for group (p=0.001) and time (p=0.001). Additionally, independent t-test also revealed significantly different were observed between pre- to post test in laboratory test ($p=0.001$) and match simulation test ($p=0.007$) displayed in Table 3. Furthermore, our statistical analyses revealed significant difference in HR was found between tests ($p=0.001$) displayed in Table 4.

Table 1. The rally characteristics of the study sample during match simulations

Pair	Lob	Drive	Smash	Drop	Net	Forced Error	Unforced Error	Service
Pair 1	27±11.31	38±8.49	19.5±7.78	25.5±4.95	1.5±0.71	3.5±0.71	6.5±3.54	19±0.1
Pair 2	26±9.90	40.5±0.71	12.5±2.12	24±5.66	3.5±3.54	6.5±0.71	12.5±2.12	15±2.83
Pair 3	30.5±2.12	47±1.41	14.5±0.71	32.5±3.54	2.5±2.12	3.5±0.71	8±7.07	17.5±0.71
Pair 4	32.5±2.12	44.5±0.71	15.5±2.12	33.5±2.12	2±2.83	3±2.83	10.5±7.78	25±9.90
Pair 5	18±9.90	34.5±10.61	12.5±3.54	33±9.90	1±1.41	2.5±0.71	10±2.83	22±4.24
Pair 6	15±2.83	28.5±0.71	9.5±3.54	20±5.66	2±2.83	3.5±0.71	9.5±6.36	18±2.83

Table 2. The differences in weight, height, BMI, body fat, VO_{2max}, VE, Rf measures on each pair of participants

Pair	Weight (kg)	Height (cm)	BMI (kg/m2)	Body fat (kg)	VO_{2max} (ml/kg/min–1)	VE (l/min)	Rf (b/min)
Pair 1	74.5±8.29	174±12.73	24.6±0.8	15.02±3.1	54.18±0.88	136.65±7.57	59.65±2.19
Pair 2	69.94±8.82	180±1.41	21.61±3.09	14.17±7.27	48.04±4.76	126.62±23.44	60.05±9.97
Pair 3	67.5±13.72	174.5±7.78	22.01±2.56	12.42±5.05	50.55±10.96	95.25±23.55	42.1±11.74
Pair 4	67.44±10.97	177±0	21.54±3.49	12.27±2.79	47.56±0.35	111.55±20.15	55±9.48
Pair 5	71.7±3.11	178±0	22.62±0.99	13.92±5.29	50.04±2.74	114.55±1.34	53.4±0.99
Pair 6	62.98±2.14	168.5±0.71	22.16±0.53	10.33±2.52	49.34±3.21	130.65±6.72	76.35±2.76
p-values[(a)]	0.83	0.55	0.76	0.91	0.82	0.26	0.49

Abbreviations:

The values are presented as mean ± SD.

(a)Superscript: one-way repeated measures analysis of variance (ANOVA).

The mean difference is significant at the $p< 0.05$ level.

Table 3. Changes in lactate measures of all participants in the laboratory and match simulations tests

Variables	Laboratory test			Match simulation test			Anova *p*-values[(a)]	
	Pre	Post	*p*[(b)]	Pre	Post	*p*[(b)]	Group	Time
Lactate (mmol/L)	2.69±1.15	12.30±3.53	0.001*	3.05±1.13	4.6±1.11	0.007	0.001	0.001*

Abbreviations:

The values are presented as mean ± SD.

(a)Superscript: A 2 × 2 repeated measures analysis of variance (ANOVA). *Values are significantly different between CG and PG groups ($p<0.05$).

(b) Superscript: Independent t-test. *Values are significantly different between CG and PG groups (p<0.05).

Table 4. Specific changes in HR average in the laboratory and match simulations tests

Variables	Laboratory test	Match simulation test	*p*-values
Average of Heart Rate (bpm)	186±10.76	152.67±13.88	0.001*

Abbreviations:

The values are presented as mean ± SD.

Statistical analysis with independent t-test.

*Values are significantly different between pre- and post-tests (p<0.05).

Discussion

The aim of this study was to assess the physiological characteristics of the Indonesian young badminton athletes in laboratory conditions and on-court conditions. To the authors' best knowledge, no available studies have reported the physiological characteristics of the Indonesian young badminton athletes. With respect to our results, this study showed that the average VO_{2max} of Indonesian young badminton athletes with category men's double is 49.95±4.45 ml/kg/min^{-1}. The results of the present study support a previous studies that found average VO_{2max} of badminton athletes with category men's double [10]. In a study conducted by Alcock et al, explained that singles players had greater predicted VO_{2max} than doubles players (50.6 vs. 45.5 mL/kg/min^{-1}).

With respect to anthropometry measurement, our results findings show how Indonesian young badminton athletes had a homogeneous profile. This may be explained by the anthropometry results of our study (height = 175.33±5.93 cm; weight = 69.01±7.55 kg; body fat (kg) = 13.02±3.80; Muscle mass in humerus dextra (kg) = 3.36±0.43; Muscle mass in humerus sinistra (kg) = 2.89±0.52; Muscle mass in trunk dextra (kg) = 11.98±1.16; Muscle mass in trunk sinistra (kg) = 12.43±1.05). On the other hand, previous studies pointed on the fact that Indonesian badminton athletes are shorter (mean 171 cm) compared with the top 13 competitors [11], for weight, asian population (specifically Indonesia) had the lowest values (mean 60 kg) [12].

In our study, we have found match characteristics of young badminton athletes with category men's double. These results are similar with other publications [13]. In a study conducted by Abian-Vincen et al, explained that average of distribution of the different shots of a badminton game with male players hit the shuttlecock more often from near the net (lob =

19 %), specifically smash=14 shots, drop=16 shots, drive=15 shots, and lob=12 shots. Although our study has been contrastingly with previous study in average of net shots. Where, in our results has shown that average of net shots is lower than previous study [14]. The disagreement in the findings from various studies probably reflects differences in characteristics games in each country.

The one phenomenon of this study showed that, HR average and post-test lactate concentration in laboratory test is higher than match simulation test in all badminton players. These results are similar to previous finding. In a study conducted by Rampichini et al, it was found HR_r vs $\dot{V}O_2$ lower in on court than in laboratory test (IIAT testing). To explain the behavior of the results obtained. Manrique et al, indicate that an adrenergic strategy was triggered in reaction to the stress produced by certain characteristics of the test, including speed, precision, and high level of concentration [8]. Furthermore, Cervantes Blasquez et al, explained that somatic stress could have further boosted the adrenergic response. Respect to our results, this phenomenon is possible, because a similar tests stress response in our study may have been caused by the type of activity and induced concurrent sympathetic activation and parasympathetic withdrawal [5].

Furthermore, the findings of this study adds to the scientific literature that supports the use of the physiological characteristics of badminton young players and to use the findings to plan training with greater precision. Although further studies are required to indicate the more underlying physiological mechanisms of badminton athletes.

Conclusion

We demonstrated that HR monitoring and lactate concentration during laboratory test is higher than match simulation. Additionally, because of the badminton games is intermittent nature, our results suggest that aerobic high-intensity intervals should preferably be used by coaches and athletes to induce the development of an endurance capacity and VO_{2max}.

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