

## VO<sub>2</sub> Max and Back and Leg Muscle Strength Profile of Universitas Padjadjaran Swimming Team

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### Abstract

**Background:** Cardiorespiratory endurance (VO<sub>2</sub> max) and back and leg muscle strength are a few components required to support the performance of swimming athlete during competition. The objective of this study was to determine the VO<sub>2</sub> max and back and leg muscle strength in high category level of Universitas Padjadjaran swimming team period 2014.

**Methods:** A descriptive study was conducted to 19 swimmers of Universitas Padjadjaran in September 2014. The variables of this study were VO<sub>2</sub> max and back and leg muscle strength. Then, the data were categorized based on the standard of The National Sports Committee of Indonesia.

**Results:** The data obtained showed that the VO<sub>2</sub> max of the majority of subjects was in the very good category (6/19 subjects) and the back muscle strength of the majority of subjects was in the very good category (10/19 subjects). In contrast, the leg muscle strength of majority of subjects was in the low category (11/19 subjects).

**Conclusions:** The VO<sub>2</sub> max and back muscle strength in high category level of the swimming team fulfilled the standard of The National Sports Committee of Indonesia. [AMJ.2016;3(4):499-502]

**Keywords:** Muscle strength, swimming, The National Sports Committee of Indonesia, VO<sub>2</sub> max

### Introduction

The performance of swimmers during competition is affected by the training that have been performed.<sup>1</sup> Training performed could affect the cardiorespiratory endurance and muscle strength.<sup>2-3</sup> Swimming requires Cardiorespiratory endurance (VO<sub>2</sub>) max and optimal muscle strength to support movement in water.<sup>4-5</sup> The VO<sub>2</sub> max of a swimming athlete tends to be higher compared to other sport athletes because the respiratory system in swimming athletes has a higher role.<sup>6-7</sup> A few muscle strengths with an important role in a swimmer are back and leg muscle strength. Leg muscle is required to kick, skim, and move faster in the water.<sup>8</sup> Back muscle is used to help rotating hands in and out, and also to help hands pulling the body in the water.<sup>9</sup>

The purpose of this study was to determine the VO<sub>2</sub> max, back and leg muscle strength

profile of Universitas Padjadjaran swimming team period 2014.

### Methods

A measurement of physical fitness components was conducted to 19 students from Universitas Padjadjaran swimming team in September 2014 at Department of Physiology, Faculty of Medicine Universitas Padjadjaran, Jatinangor. This study was approved by Health Research Ethics Committee of the Faculty of Medicine, Universitas Padjadjaran. This study was conducted to all active swimming team members in the high category level who met the inclusion and exclusion criteria. The inclusion criteria were students registered as member of high category level of the swimming team period 2014, aged between 18-25 years, and healthy. Exclusion criteria were participants in a state of fatigue, taking drugs and drinks

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**Table 1 General Characteristics of High Category Level of Universitas Padjadjaran Swimming Team**

	Male (n=16)			Female (n=3)		
	median	min*	max**	median	min	max
Age (years)	20.50	19	25	18.00	18	19
Weight (kg)	60.00	49	78	56.00	46	70
Height (cm)	168.00	158	183	161.00	153	162
Pulse rate in maximum activity (pulse/minute)	138.00	100	184	160.00	136	164
Respiratory rate (frequency/minute)	70.00	60	75	70.00	62	70
Systole (mmHg)	110.00	98	124	100.00	90	114
Diastole (mmHg)	75.00	60	88	72.00	70	75

Note: \* minimum value \*\*maximum value

that could increase the work of the heart and muscle strength, other drugs causing palpitations, coffee, tea, and energy enhancer supplements. There were 19 students met the inclusion criteria consisting of 16 males and 3 females.

Before performing the test, the subjects were given an adequate explanation about the purpose, objective, and procedure of examination. Then the subjects filled a willingness form to participate in the test and the subjects underwent physical examination measurement included height measurement, weight measurement, breathing rate measurement, and blood pressure measurement. After that, the subjects underwent measurement of muscle strength by using dynamometer.

The process was then continued with measurement of  $VO_2$  max using Astrand-Rhyming chair test for 5 minutes. The pulse rate was measured by pressing radial artery in wrist in a line with thumb, immediately after completing Astrand-Rhyming chair test. The result was applied to Astrand nomogram

according to age, sex, and weight of subject to determine the level of  $VO_2$  max. The results were calculated to get median, minimum, and maximum value of  $VO_2$  max, back and leg muscle strength with statistics software, and then were categorized based on the standard of The National Sports Committee of Indonesia.

## Results

The range of male subject's age was 19–25 years old, range of male subject's weight was 49–78 kg, range of male subject's height was 158–183 cm, and range of male subject's pulse rate in maximum activity was 100–184 pulse/minute. The range of female subject's age was 18–19 years old, range of female subject's weight was 46–70 kg, range of female subject's height was 153–162 cm, and range of female subject's pulse rate in maximum activity was 136–164 pulse/minute. Respiratory rate, systole, and diastole of all subjects were in normal limits (Table 1).

Based on Table 2, range of male subject's

**Table 2  $VO_2$  Max, Back and Leg Muscle Strength in High Category Level of Universitas Padjadjaran Swimming Team**

	Male (n=16)			Female (n=3)		
	median	min*	max**	median	Min	max
Back Muscle Strength (kg)	123.75	86	220.5	80.50	60	80.5
Leg Muscle Strength (kg)	141.00	92	202	95.50	72.5	134
$VO_2$ Max ( $O_2$ /kg weight/minute)	54.50	32	109	39.00	37	50

Note: \* minimum value \*\*maximum value

**Table 3 Results of VO<sub>2</sub> Max in High Category Level of Universitas Padjadjaran Swimming Team based on Standard of the National Sports Committee of Indonesia**

Category	Frequency (person)	
	Male	Female
Less	2	0
Enough	3	0
Good	2	3
Very good	6	0
Perfect	3	0
No data	0	0
Total	16	3

**Table 4 Results of Back Muscle Strength in High Category Level of Universitas Padjadjaran Swimming Team based on Standard of The National Sports Committee of Indonesia**

Category	Frequency (person)	
	Male	Female
Very less	0	0
Less	0	0
Average	6	0
Good	3	0
Very good	7	3
Total	16	3

back muscle strength was 86–220.5 kg, range of male subject's leg muscle strength was 92–202 kg, and range of male subject's VO<sub>2</sub> max was 32–109 O<sub>2</sub>/kg weight/minute. The range of female subject's back muscle strength was 60–80.5 kg, range of female subject's leg muscle strength was 72.5–134 kg, and range of female subject's VO<sub>2</sub> max was 37–50 O<sub>2</sub>/kg/min.

The VO<sub>2</sub> max of 6 of 16 male subjects and all female subjects were in very good category based on standard of The National Sports Committee of Indonesia.

Based on Table 4, back muscles strength of 7 of 16 male subjects and all female subjects were in very good category based on standard of The National Sports Committee of Indonesia.

Based on Table 5, leg muscle strength of 9

**Table 5 Results of Leg Muscle Strength in High Category Level of Universitas Padjadjaran Swimming Team based on Standard of The National Sports Committee of Indonesia**

Category	Frequency (person)	
	Male	Female
Very less	0	0
Less	9	2
Average	7	1
Good	0	0
Very good	0	0
Total	16	3

of 16 male subjects and 2 of 3 female subjects were in the low category based on standard of The National Sports Committee of Indonesia.

## Discussion

The result of swimming team's  $VO_2$  max showed that most of the subjects were in the very good category based on standard of The National Sports Committee of Indonesia. This result was in accordance with the study conducted by Doewes et al.<sup>6</sup> which stated that swimming athletes have higher  $VO_2$  max compared to other athletes because they have higher tidal volume contributions. The high condition of  $VO_2$  max in swimmers is also affected by supplying and demanding oxygen in the body which increases every minute.<sup>10</sup>

The strength of back muscle of the swimming team met the standard of The National Sports Committee of Indonesia. The result showed that most of the subjects were included in the very good category. This result is in accordance with the study conducted by Su et al.<sup>9</sup> which stated that back muscle strength is needed by swimmers to support hand movements in rotating out or in and to support hands pulling the body in water. Hand movements to pull the body are also affected by high training intensity.<sup>11</sup> However, the swimmers' leg muscle strength was far below from the standard of The National Sports Committee of Indonesia. A swimmer needs a good strength of leg muscle when skimming which also affects the speed of swimming.<sup>11</sup> A low category of the swimmers' leg muscle strength was believed to occur because they had not reached the same training as the national swimming athletes.

The conclusion of this study is the  $VO_2$  max and the strength of back muscle of most subjects are in the very good category based on standard of The National Sports Committee of Indonesia, while leg muscle strengths of most subjects are in the low category.

Limitation of this study was the small sample size. From this study, it is suggested that Universitas Padjadjaran swimming team is required to train periodically especially weight training 8–12 repetition maximum (RM) to increase the strength of the leg muscles.

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