



DETERMINATION OF ENERGY NEEDS OF KU-IV SWIMMING ATHLETES AT THE KRAKATAU ATLANTIC SWIMMING ASSOCIATION (PRKA) SWIMMING CLUB

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ABSTRACT

Swimming is an aquatic sport in which almost all members of the body require coordination of motion. Not only that, but swimming also includes sports that are programmed for achievement by competing at speed, both short, medium, and long distances. The Krakatau Atlantic Swimming Association (PRKA Swimming Club) is one of the first and oldest swimming clubs in Cilegon which was formed on July 7, 1990. This association is chaired by Drs. Zuladri Firman. The training program is held six times per week: Tuesday, Thursday, and Saturday at 16.00 – 17.45 WIB and Monday, Wednesday, and Friday at 05.00 – 06.30 WIB. On Sundays, ground or physical training is carried out at 07.00 – 09.00 WIB. Age group (KU) IV athletes to achieve maximum performance, need an optimal training system and appropriate energy requirements. Based on the calculation results, the average energy requirement for KU-IV athletes is 1.64 kcal/minute.

Keywords: Swimming, Energy Need, Ergonomic. Cardiovascular

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1. INTRODUCTION

The development of swimming science and technology is increasingly significant. Swimming includes aquatic sports where almost all limbs require coordination of motion. Not only that, but swimming also includes sports that are programmed for achievement by competing speed, both short, medium, and long distances (Narlan, et al., 2019).

Perkumpulan Pool Krakatau Atlantik (PRKA *Swimming Club*) is one of the first and oldest swimming clubs in Cilegon City which was formed on July 7, 1990. This association is chaired by Drs. Zuladri Firman. PRKA *Swimming Club* has produced many outstanding altitude seeds in various Cities, Provisions, and National championships. Based on the club's 2022 membership data, it consists of 16 coaches and 50 athletes. The exercise program is run six times per week: Tuesday, Thursday, and Saturday at 16.00 – 17.45 WIB and Monday, Wednesday, and Friday at 05.00 – 06.30 WIB. On Sunday, land or physical training is carried out at 07.00 – 09.00 WIB. According to the *Federation Internationale de Natation de Amateur* (FINA) in the division of training groups are divided based on age groups (KU), namely: KU senior (age range 18 years and over), KU I (age 15-17 years), KU II (age 13-14 years), KU III (age 11-12 years) and KU IV (under the age of 10 years).

Age group (KU) IV athletes to achieve maximum performance, require an optimal training system. The energy needs needed by athletes are directly proportional to rest periods, otherwise, this will result in a decrease in the physical condition of athletes (Ita, 2014). One method can be done in calculating the energy needs and length of rest time of the athlete with 10 pulses of the athlete at the time of doing the training program. The higher the number of pulses calculated/per minute, the more rest needs will be (Rahayu, 2020). A similar research was conducted by Elva Susanti (2018) who conducted a study to know the average energy consumption after exercise to anticipate fatigue in sports. Dony and Rivialsha (2018) also conducted load analysis research on archery and referred to improve the quality of quality owned by calculating pulse rate and energy consumption. Siti Rahayu₁₄₀₀ (2013) calculated the physical workload received by the operator and determined the optimal rest time.

2. METHODS

The following are the stages in the research conducted:

1. Data collection

Data collection was carried out by face-to-face method directly on KU-IV athletes at Krakatau Atlantik *Swimming Club*. The data used include name, age, measurement of 10 pulse rate before doing the exercise program, and measuring 10 pulse rate when doing the exercise program five times.

2. Data processing

- a) Calculation of initial/resting pulse rate (DNI) for each KU-IV athlete at Krakatau Atlantik *Swimming Club* using the formula:

$$DNI = \frac{10 \text{ beats}}{\text{Time counts}} \times 60$$

- b) Pulse calculation when KU-IV athletes at Krakatau Atlantik *Swimming Club* perform a training program (DNK) using the formula:

Average NK = Number of 10 pulses during the exercise program five times

Measurement of (n)

After getting the results of the above formula, proceed again to the next formula, namely:

$$DNK = \frac{10 \text{ beats}}{\text{Average NK}} \times 60$$

- c) The calculation of the maximum working pulse rate (DNKmax) of KU-IV athletes at Krakatau Atlantik *Swimming Club* uses the formula:

DNKmax = Maximum Pulse Rate, if male:
220 – age / Female: 200 – age

- d) Work Pulse (NK) of KU-IV athletes at Krakatau Atlantik *Swimming Club* using the formula:

DNK = Working Pulse (DNK) – Initial Pulse Rate (DNI)

- e) Calculation of %HR Reverse in KU-IV athletes in Krakatau Atlantik *Swimming* to determine the potential increase in pulse from rest to the maximum. The formula used is as follows:

$$\%HR \text{ Reverse} = \frac{DNK - DAYS}{DNI_{max} - DNI}$$

- f) Calculation of *Cardiovascular strain* (%CVL) of KU-IV athletes at Krakatau Atlantik

Swimming Club to determine workload classification (seen in Table 1) based on pulse rate increase with maximum pulse rate. The following formula is used:

$$\%HR\ CVL = \frac{100 \times (DNK - DNI)}{DAYS_{max} - DAYS}$$

Table 1. Klasifikasi % Cardiovascular Strain (CVL)

%CVL	Classification
<30%	No slippage
30 – 60 %	Improvement required
60 – 80 %	Work in a short time
80 – 100 %	Immediate action required
>100 %	No activity allowed

- g) Calculation of energy consumption of KU-IV athletes at Kratau Atlantik *Swimming Club* when conducting a training program with a regression approach as follows:

$$Y = 1.80411 - 0.0229038X + 4.71733.10^{-4}X^2$$

Ket:

$$Y = \text{Energy (kilocalories/min)} \times X$$

$$= \text{Pulse rate/min}$$

Table 2. Classification Based on Energy Consumption

Employment Rate	Energy Expenditure	
	Kcal/min	Kcal/8h

Table 3. DNK Measurement of KU-IV Athletes

Athlete Name	Age (years)	10 beats (seconds)	1	2	3	4	5
Khanza	9	8.78	7.03	6.89	6.58	6.2	7.73
Banyu	10	9.2	8.29	7.88	6.77	6.8	8.23
Tian	8	9.35	8.59	8.15	7.88	6.79	8.3
Abi	9	9.21	8.7	8.29	7.9	6.78	7.79
Road	8	8.57	8.02	7.25	6.8	6.82	7.87
Bar	10	8.27	7.15	6.11	6.1	6.12	7.89
Adit	11	8.9	7.52	7.92	7.8	7.71	7.19
Attachment	11	9.09	7.44	7.2	6.92	6.02	8.78
Ghaisan	7	8.34	7.49	7.1	6.72	6.69	7.4
Conqueror	10	8.55	7.89	7.12	6.78	6.55	7.29
Azzam	11	7.34	6.51	6.7	5.62	5.7	6.71

Based on the measurement results using a predetermined formula, the results of the pulse recapitulation of KU-IV athletes at the Krakatau Atlantik *Swimming Club* were obtained, the greater the DNI, DNK, and NK values, the athletes had not previously carried out activities such as

Table 4. Recapitulation of the pulse of KU-IV athletes during an exercise program

Undully heavy	>12,5	>6000
Very heavy	10,0-12,5	4800-6000
Heavy	7,5-10,0	3600-4800
Moderate	5,0-7,5	2400-3600
Light	2,5-5,0	1200-2400
Very light	<2.5	<1200

3. Data Analysis

Data analysis was carried out at the last stage to determine the average energy consumption required for KU-IV athletes at the Krakatau Atlantik *Swimming Club*.

3. FINDINGS AND DISCUSSION

The following are the results of direct observations and measurements on KU-IV athletes at the Krakatau Atlantik *Swimming Club*, both during rest time and doing training programs with a vulnerable time of 1 hour 45 minutes/day. The timing of 10 beats was performed five times using a *stopwatch*. The following is the DNK measurement table for KU-IV Athletes:

warm-up exercises or activities after school meaning that they were not tired and carried out the exercise program casually / unburdened. The following is a recapitulation result of the calculation:

Athlete Name	DAYS	DNK	DNK (max)	NK
Khanza	68.34	87.13	191	18.80
Banyu	65.22	79.01	210	13.79
Tian	64.17	75.55	212	11.38
Abi	65.15	76.03	211	10.88
Road	70.01	81.61	192	11.60
Bar	72.55	89.90	210	17.35
Adit	67.42	78.66	209	11.24
Attachment	66.01	82.51	209	16.50
Ghaisan	71.94	84.75	213	12.80
Conqueror	70.18	84.20	210	14.02
Azzam	81.74	96.03	209	14.29

Based on the results of calculations and analysis, the average *Cardiovascular Strain* (%CVL) is 13.54% in KU-IV athletes when doing an exercise program and can be classified as not experiencing a lag because of the value of < 30%.

Meanwhile, the average determination of athlete needs is 1.64 kcal / minute. The following is a table of the results of the 10-pulse method of KU-IV athletes when training:

Table 5. Results of the 10 Pulse Method of KU-IV Athletes When Performing an Exercise Program

Athlete Name	Average DNI	DNK Average	DNK average (max)	HR Reverence	CVL	Energy Consumption
Khanza	68.34	87.13	191	18.44	18.44	1.65
Banyu	65.22	79.01	210	13.48	13.48	1.63
Tian	64.17	75.55	212	11.07	11.07	1.62
Abi	65.15	76.03	211	10.57	10.57	1.62
Road	70.01	81.61	192	11.23	11.23	1.64
Bar	72.55	89.90	210	17.00	17.00	1.65
Adit	67.442	78.66	209	10.92	10.92	1.63
Attachm ent	66.01	82.51	209	16.19	16.19	1.64
Ghaisan	71.94	84.75	213	12.47	12.47	1.64
Conquer or	70.18	84.20	210	13.69	13.69	1.64
Azzam	81.74	96.03	209	13.90	13.90	1.66

4. CONCLUSION AND SUGGESTION

The average result of calculating the energy needs of KU-IV athletes at Krakatau Atlantik *Swimming Club* of 1.64 kcal / minute can be interpreted as the exercise program is categorized as light and fatigue does not occur.

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