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The Periodization of 4 and 6 Weeks Circuit Training and Age to Improve the Aerobic Endurance of Basketball Beginner Athletes

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***Abstract*—This study aims to reveal: (1) the periodization 4 week and 6 week circuit and the aerobic endurance of basketball beginner athletes, (2) the periodization of 4 weeks and 6 weeks circuit training and age on the aerobic endurance of basketball beginner athletes, and (3) the interaction of the periodization of 4 weeks and 6 weeks circuit training on the age difference and the aerobic endurance of basketball beginner athletes. This research method was experimental with the factorial design of 2 x 2. The population was 52 basketball beginner athletes, aged 16 to 18 years old. A sample of 20 basketball beginner athletes was established using the random sampling technique. The instruments to measure the endurance ability was the multistage fitness. The data analysis technique used was two-way ANOVA at the significance level of α = 0.05. The results of the research are as follows. (1) There is a significantly different effect of 4 weeks and 6 weeks circuit training on the acrobic endurance (calculated F = 10.258 while the value of significance p of 0.001). Because of the value of significance p of 0.001<0,05, there is a significant difference between 4 and 6 weeks circuit exercises. (2) There is a significantly different effects between 4 weeks and 6 weeks circuit training on the athletes age 16 and 18 on the aerobic endurance with F count = 8043.2 while the value of the significance p of 0.000. with the value of the significance p of 0.000 < 0.05 which means there is a significant difference between 4 weeks and 6 weeks circuit training and the age and the aerobic endurance. (3) There is an interaction between 4 weeks and 6 weeks circuit training and the age at the significance level of calculated F = 16.426 while the value of significance of 0.000,< 0.05 proved the absence of interaction that is significant between the 4 weeks and 6 weeks circuit training and the age.**

Keywords—periodization, age, endurance, basketball introduction

I. INTRODUCTION

Basketball is a sport that requires high levels of concentration and skill. According to [18], in accordance with its characteristics, basketball is an intense, strong, fast, and aggressive sport, hence requiring very good endurance. [7] also argues that the endurance of basketball athletes requires dominant abilities such as strength and speed. In order to support an intense sport such as basketball, athletes must first increase their aerobic endurance [1].

Aerobic endurance is the most basic quality in basketball, as basketball is a group sport that requires every player to be in harmony in order to sustain the game [27]. Whereas according to [11], the aerobic endurance of an athlete must be tailored to their physiology. Therefore, two training methods were devised, first of which involves increasing the athlete's physiology to maximize their physical conditions in accordance to their respective sporting fields [7]. Circuit training is especially effective in increasing one's aerobic endurance [39]

Circuit training consists of several posts, in which athletes perform a predetermined set of movements. In its essence, every method that trains endurance must not veer too far off its intended purpose. The program will help increase an athlete's endurance, strength, and speed, with visible results for ages 16 years and above [3]. Circuit-based training programs performed at this age are effective for increasing muscle, cardiovascular, agility, and endurance [41]. This is in line with [6] who states that 16-18 is the best age for physical training programs, where we can determine which strenuous or light programs are best. Moreover, people in this age group can start specializing their training for their respective sporting fields. One way to achieve this is through training periodization.

Periodization is the systematic planning of athletic or physical training. The aim is to reach the best possible performance in the most important competition of the year. It involves progressive cycling of various aspects of a training program during a specific period [7]. An effective periodization of exercises is two or three times per week which allows for an effective training that significantly improves the strength, speed, agility, flexibility, and cardiovascular endurance of an athlete, where results are visible in the first 4th and 6th week [22].

A four-week circuit training that follows procedure significantly improves lower and upper strength and endurance [10]. Therefore, a four-week circuit training program is great for preparing novice athletes or a general pre-training periodization before a match [7]. By implementing this four-week circuit training regime, one can expect to see an increase in their endurance and strength, where the body adapts to specific techniques and tactics based on physiological response. On the other hand, [30] believes that a good training program for general pre-match periodization is best performed for six weeks through circuit training. In other words, it is proven that a four and six-weeks

circuit training improves cardiovascular, endurance, making it the perfect training regime for pre-match preparation. Therefore, coaches hold a crucial role in devising and scheduling the appropriate training regime for their athletes by taking into account the age of their athletes, where endurance, strength, and flexibility varies from athlete to athlete [7]

II. Related Works/Literature Review

Endurance is observed through muscle performance, which is the ability of the muscle/muscle group to perform within a certain duration. Observed from an energy system point of view, it is the ability of internal organs to perform within a certain duration. Endurance is also referred to as a self-defense control by utilizing oxygen to ensure in-game performance; better endurance equals to better performance [31].

Good endurance is the basic human ability to perform physical activities, be it high or low duration activities. In a basketball game, one must have great endurance to support his or her performance in-game. Training must start in a gradual manner, starting with low intensity and moving up as time passes to ensure improvement and avoid fatigue. This method allows athletes to gradually improve their speed, agility, explosive power, maximum strength, and endurance, with the latter a key requirement in basketball [33]. Great endurance will help the athlete to complete other programs in the future [12]. Having great endurance will greatly improve muscle strength. Endurance training does not only positively impacts physique in adults, but also psychological development in children [35]. Increased physical fitness not regardless of the presence of exercise program applied to improve physical ability in order to sustain the game or sports in the field will affect the cells of the body become more better [36]. Endurance gained from training is beneficial for an athlete's cardiovascular endurance and strength, therefore making them healthier [7]. The intensity of training for every novice athlete will greatly affect their development, hence it requires their muscle and inner organs to adapt to said training. Through training, the improvements in pulmonary and cardiovascular functions help greater blood flow which in turn increases the athlete's energy output and efficiency in energy consumption. These improvements can be categorized and observed on an age basis [8].

The earliest endurance development occurs between the age of 15-17 due to juvenile muscle development. Training at this age significantly develops upper and lower muscles [37]. An athlete's endurance reaches maturity when it meets their respective sporting fields' standards, be it team based sports or individual sports. One must train repeatedly beforehand to meet these standards [7]. This maturity will enhance one's ability in their respective sports, such as increasing their striking speed and agility in the face of an opponent. Such will also improve an athlete's strength and speed; both dominant features in high endurance [7].

High endurance training aims to maximize muscle fibers. High endurance training is also very suitable to perform in football, basketball, and rowing or in sports that requires non-stop movement due to repetitive muscle movements [7]. The target in each training program requires the body to adapt to the training. That is why a high-level training program is effective when adjusted to the body's ability in advance. Jumping straight to high intensity training will result in injuries, therefore this gradual increase applies to female and male athletes alike. Training periodization intends to adjust the level of training to the athletes' bodily responds, with the hope that it will increase their ability during the course of the periodization (Bompa, 2000: 152).

Periodization in this context is a preparation period for a competition. Periodization here is a weekly exercise that is prepared for each stage of repetition used to improve the ability of athletes, especially novice athletes and tailored to the response of the body in preparation for the planning of an exercise program. The periodization of exercise is a powerful and very effective tool for improving the body's response to adaptation [9].

Periodization is done with several stages to improve the ability of athletes who are prepared to face competition or improve the response of the body in accordance with the training program [9] training periodization for enhancing the following abilities:

1. Anatomical adaptation (AA) is done both to athletes who have been trained and not trained to adapt the body with the exercise program that has been given.
2. Hypertrophy (H) are stages of training tailored to the goals to be achieved in a prepared training program.
3. Maxed training (MT) are stages of training conducted with a variety of exercise programs using the periodization and improvement of the ability and response of the body in accordance with the exercise program.
4. Maximum strength (MXS) Maximum capability increases with length of training performed to improve skill and muscle density trained.
5. Muscle definition (MD) training program that is prepared based on this periodization with the aim to burn fat in the body to improve posture so that it is easier for athletes to adapt to the prepared training program.
6. Transition (T) rest periods that run during the training program on the run or also the race that run.

Periodization for training programs is an effective program to shape personalized workouts better and gradually increase according to the response of the body with different programming plans to suit the needs of the sports that are occupied [9]. Sports that are in both the sport of individual and group periodization of training in this regard is inseparable from the initial ability to improve strength, speed, coordination requires good endurance capability, endurance ability in the sport is divided into two parts namely aerobic endurance and anaerobic endurance.

It can be concluded that the ability of endurance is the ability of a person to take advantage of oxygenin the conduct of the movement be it with low intensity or ed ability good durability very influential on the performance of the athlete and therefore the ability good durability that athletes tungal or the athlete's team is very important for tingaktakan to support the techniques and tactics that have been trained, durability in the be of endurance aerobic and endurance anaerobic.

Aerobic endurance is very effective in group games where in group games it will be very effective to help keep stability of heart rate and oxygen [9], improve the ability of aerobic endurance especially in highly effective group exercise by doing circuit training exercises will enhance the strength and speed of basketball athletes in line with previous thinking according to [23] aerobic endurance capability in group games is needed to improve the ability of endurance in order to maintain the stability of muscle strength, speed, and endurance an doing circuit training exercises. According to [25] if it has good aerobic ability well then it will maintain the stability of the body, muscle performance will be better and more stable when doing good body movement in terms of high intensity According [24] has a good aerobic ability will be very helpful what when doing a high body activity aerobic ability will remain awake body composition, heart rate and impact on health for the better. for that what if a good ability to have a good exercise program and adequate to improve the ability of endurance aerobic [32] training program to get a good aerobic endurance ability must be adjusted with the characteristics or with physical conditions athlete in order to obtain the aerobic endurance capability expected [2]. what aerobic endurance capability has improved when the anaerobic endurance capability also gets better.

The ability of endurance aerobic said to be good when someone can maintain the stability of the kinarja muscle in setiab perform the movement with either high intensity or low to maintain the ability to condition the body to perform movements that match with the characteristics or the branch sports field, what if the ability of endurance aerobic suda stable with so intensity ;atihan can be tinkatkan to improve the ability of endurance anaerobic.

Anaerobic endurance is a high intensity movement not only for individual sports requiring high-intensity movements in football sports such as soccer and basketball, but also in high intensity need for the role of trainer to design programs to train anaerobic ability to improve [17] high-intensity sports such as sprinter sprinters and the likes of soccer and basketball strongly need the ability to do so in order to train anaerobic abilities of a knowing trainer and exercise goals and physiological characteristics [16] training program to improve anaerobic ability first requires adaptation of anatomy body to familiarize the body with the exercise so as not to happen anymore injury to the program long term is very important to note the adaptation of anatomy [28], in line with it According to [38] adaptation of body anatomy or target muscles are trained very important in giving treatment to strengthen it so muscles become accustomed and become better because of the treatment given to the muscles to be trained.

High-intensity exercise programs in certain sports greatly require anaerobic ability to support athlete's game in the field, games that require concentration such as basketball games require good co-ordination skills to control the movement to be performed, coordination plays an important role in any movement either movement with low or high intensity to be effective and efficient [34], Confidence and character are seen on the basis of excellent ability to train anaerobic endurance skills ranging in age from 16 to 18 years of age from 16-18 muscle abilities have started well and can be used for high intensity exercise program, The program for anaerobic training should not be conducted according to the will of the trainer, but in line with the athlete's mood. If the athletes' mood is great, the training program to increase anaerobic performance will be more successful [13]. In line with previous research [42], aerobic and anaerobic power training programs are inseparable from increasing dominant forces to improve athlete's ability, therefore mood is also critical in enhancing these capabilities.

III. METHODS

This research implements 2x2 factorial design [14] with population consisting of novice basketball athletes age 16 and 18 with a 1 year training experience and employing ANOVA two-way statistics test with a significance level of 0.05 for measuring multistage fitness. The design can be seen in table 1.1.

TABLE I. DESIGN FACTORIAL

Age (B)	**Circuit training program (A)**	
	4-week circuit training for age 16 (A1)	**6-week circuit training for age 18 (A2)**
Age 16 (B1)	(A1B1)	(A2B1)
Age 18 (B2)	(A1B2)	(A2B2)

Explanation

A1 : 16-year-old circuit training
A2 : 18-year-old circuit training
B1 : 16-year-old athletes
B2 : 18-year-old athletes
A1B1 : (age-group 16) 5 people given the treatment of circuit training
A2B1 : (age-group 18) 5 people given the treatment of circuit training
A1B2 : (age-group 16) 5 people given the treatment of circuit training
A2B2 : (age-group 18) 5 people given the treatment of circuit training

IV. RESEARCH PROCEDURE

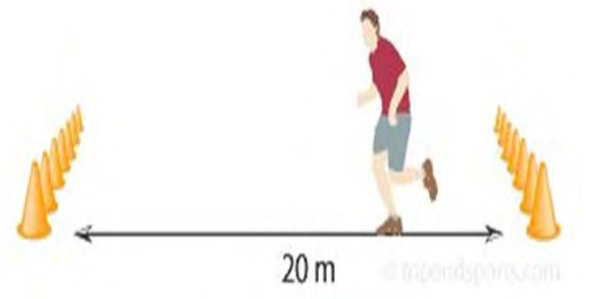
a. Observe the would-be site of the research in GMC Cirebon basketball club by using samples within the age 16 and 18 years.
b. Determine which sample to be used in the study
c. After the samples are obtained, they are randomized
d. Provide initial test measurements to determine the athletes' ability
e. Giving tread man for 4 weeks and 6 weeks The research data are pretest and posttest data which are general descriptions of each related variables in the research. The study was conducted on basketball athletes. Pretest data collection was conducted on Wednesday, February 21, 2018 while posttest data retrieval was conducted on Wednesday, March 24 (4 weeks) and Wednesday 10 April (6 weeks) 2018 at 4 PM. Treatments were carried out as much as 12 x exercises (4 weeks) and 18 x exercises (6 weeks), with the same frequency of 3 meetings per-week, every Tuesday, Thursday and Saturday. The following are pre-test and posttest aerobic endurance results by testing pre-program and post-program aerobic endurance.

V. PARTICIPANTS

The research participants were novice athletes from GMC Cirebon with an age of16 and 18, in which athletes within the age 16 were given 4 weeks of training whereas athletes within the age of 18 were given 6 weeks of training. There were thirty (30) 16- year-old consisted of 14 male athletes and 16 female athletes, and twenty-two (22) 18-yearold athletes consisted of 12 male athletes and 10 athletes. 4 weeks training is represented as (A1B1), 6 weeks training is symbolized as (A2B1), 4 weeks of training is symbolized as (A1B2), and 6 weeks training is symbolized as (A2B2).

VI. MEASUREMENT METHOD

TABLE II. THIS RESEARCH IMPLEMENTS MULTISTAGE FITNESS TEST TO MEASURE THE AEROBIC ENDURANCE OF NOVICE BASKETBALL ATHLETES



[26] Validitas 0, 975 and nilai reliabilitas 0,84. meanwhile, according to [15] Validitas 0.93 and Reliability 0.87

The purpose of this test is to measure how the athletes' aerobic endurance develop over the course of the training program. Testing equipment for multistage fitness are: a flat field, measuring tape, cones, speakers, beep test audio, and assessment sheets.

1. Statistical data analysis

TABLE III. DESIGN DATE ANALYSIS STATISTICAL

Usia	Endurance aerobic	N	Statistic	Pretest	postest
Usia 16	4-week circui training Periodization (A1B1)	5	Sum	211.6	237.3
			Mean	41.86	47.46
			SD	7,6	8.8
	6-week circuit training Periodizatio n (A2B1)	5	Sum	20.9	209.3
			Mean	40,22	40,72
			SD	47	5.8
Usia 18	4-week circuit training Periodizatio n (A1B2)	5	Sum	201.1	203.6
			Mean	38,64.	41,6
			SD	1.5	1.1
	6-week circuit training Periodizatio n (A2B2)	5	Sum	188.9	192.5
			Mean	37.78	38.51
			SD	2.3	2.4

The results of the counting Statistics of pre test and post test endurance aerobic periodization 4 week and 6 week circuit training with the age of 16 and 18 Ease of Use.

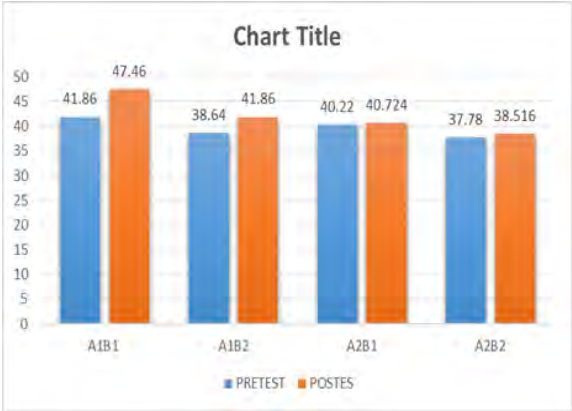


Fig. 1. Block diagram Chart of the average aerobic endurance of athletes age 16 and 18

Based on the pretest and posttest results, there are significant difference between athletes in the 16 and 18 age groups. Athletes age 16 years with 4-week training periodization have an average score of 47.46, and 41.86 for those in the 6-week training periodization. On the other side of the spectrum, the 4-week training periodization have an average score of 38,78 and 36,51 for those in the 6-week training periodization. Thefollowing is the normality test for age group 16 and 18:

2. Research Results

a. Hypothesis: 4-week and 6-week circuit training periodization yielded differentresults in the aerobic endurance of novice basketball athletes.

TABLE IV. THE EFFECT OF DIFFERENCES IN 4 WEEK AND 6 WEEKS CIRCUIT TRAINING

Source	*Type III Sum of Squares*	*Df*	*Mean Square*	*F*	*Sig*
Training metod	76.206	1	76.206	17.258	0.001

From the ANOVA test result in table 4.1, it can be seen that F arithmetic = 17.258 and *p* significance value equal to 0.001, Because p significance value is equal to 0.001> 0,05, H0 was rejected. Hence there is a difference in the effects of 4-week and 6-week circuit training on the aerobic endurance of novice basketball athletes. Based on the results of the analysis, 4-week circuit training method is better than the 6-week exercise. The 4-week training method yielded an endurance value of 47.46, whereas age-group 18 with 6-week training yielded an endurance value of 38.5 with seconds of differences. This indicates that the research hypothesis (H1) which states that "there is difference in the effects of 4-week and 6-week circuit training on the aerobic endurance of basketball athletes" is accepted.

b. Hypothesis: Age difference in the 4-week and 6-week circuit training periodization yielded different results in the aerobic endurance of novice basketball athletes.

TABLE V. AGE-GROUP 16 AND 18 CIRCUIT TRAINING ON AEROBIC ENDURANCE

Source	*Type III Sum of Squares*	*Df*	*Mean Square*	*F*	*Sig*
Age	127.008	1	127.008	28.764	0.000

From the ANOVA test result in table 4.2, it can be seen that F arithmetic = 28.754 and *p* significance value equal to 0.000, Because p significance value is equal to 0.000> 0,05, H0 was rejected. Based on this result, the was a significant difference in the effects age on the aerobic endurance of novice basketball athletes. Based on the results of the analysis, athletes within the age of 16 yielded better results than their 18- year-old counterparts. After the 4-week and 6-week training, 16-year-old athletes yielded different values with an average of 5.04. This indicates that the research hypothesis (H1) which states that "there is a significant difference in the effects of 4 weeks and 6 weeks aerobic endurance between the age of 16 and 18" is accepted.

c. There was an interaction of periodization 4 week and 6 week circuit training with age on the ability of endurance aerobic Athletes basketball beginners

Endurance aerobic	***Type III Sum of Squares***	***Df***	***Mean Square***	***F***	***Sig***
Kelompok latihan * usia	72.532	1	72.532	16.426	0,000

From the results of the ANOVA test in table 4.3 above, it can be seen that the group exercise F calculate = 16.426 0.000 significance < 0.05 As the significance value of F count 16.426 while the p of 0.000 < 0.05, mean Ho is rejected. By this means the hypothesis which states “there is a significant interaction between exercises (4 weeks and 6 weeks) and aged (16 and 18) towards the ability of endurance aerobic athletes basketball beginners” HO is rejected, based on this means the hypothesis which states there is a significant interaction between exercise group with age (16 and 18) on the ability of endurance athletes basketball beginner H1”in thank

3. Discussion

Discussion of the results of this research provides further interpretation of the results of the data analysis that has been put forth. Based on the hypothesis testing, the research yielded three group of conclusion analysis: (1) there are differences in effects of the training program; (2) there is a significant difference in the effects of training factors and age 16 and 18 years in the research; and (3) there was a significant interaction between the 4 weeks and 6 weeks of training routines with the age of the athletes. Discussion on the results of the analysis can be are as follows:

Based on the hypothesis test, it is known that 4 weeks and 6 weeks circuit training has a significant effect on aerobic endurance based on exercise group and age. There is a significant difference due to the significance value of p = 0,001 <0.05. The results also showed that the 4-week circuit training is better than the 6-week circuit training for basketball athletes’ aerobic endurance.

According to [20], set based training programs that are adjusted to the characteristics, circuit training in particular, helps build blood and oxygen flow. Circuit training with its number of posts helps athlete improve their endurance and are very suitable for improving strength and endurance in novice athletes. All of which are in line with [6] The relationship of 4-week and 6-week exercise circuit with the athlete’s age are as follows:

The resulting aerobic endurance from the circuit training that are grouped based on the age and training group using 4-week and 6-week circuit training are different due to the *p* significance value of p = 0.000 < 0.05, in which based on the age group there is a significant difference due to p = 0.000 < 0.05. Training programs undertaken for enhancing the ability of athletes from two training age-group, utilizing rest periods for strength recovery, requires periodization over an extended period of time to maximize the athletes’ power. Seen from the intensity and length of the training program, athletes in age-group 16 are more dominant in increasing their maximum potential compared to their 18-year-old counterpart.

Circuit training that are implemented on athletes within the age of 16 over a long period will yield better aerobic endurance [4].[21] agreed with this notion, stating that training programs with an intensity of 3 sessions per-week over a period of 4 weeks can improve muscle endurance, fitness, and cardiovascular endurance. Hence it is crucial for coaches to adjust their training programs to the age group of their novice athletes in order to effectively improve their aerobic endurance.

This research concludes that there is an interaction between the aerobic endurance of novice athletes and circuit training (4 and 6 weeks of training in correlation to the age of the athletes). The *p* value of p = 0.000 < 0,05 indicates that the main factors in this research show a significant interaction, therefore the effectiveness of circuit training is affected by the age of the athletes and the length of the training itself [40]. In many sporting fields, especially basketball, athletes must maintain their aerobic endurance, be it lower or upper muscle endurance, to better compete in real-world matches.By implementing short-term circuit training, athletes cannot only improve their aerobic endurance, but also their cardiovascular endurance, as well as lower and upper muscle strength. This endurance is important in short-patterned sports such as basketball where short term training improves aerobic endurance and cardiovascular endurance [5]. Endurance training will be much moreeffective and show more significant improvements in an athlete’s strength and ability to

withstand exhaustion if the training is implemented starting from the novice level all the way up to advanced level [29]

VII. Conclusions

1 There is a difference periodization exercise 4 weeks and 6 weeks against the aerobic endurance athlete basketball beginners.

2. There is a difference between the age of 16 years and 18 years against the aerobic endurance athlete basketball beginners.

3. The interaction between periodization training (4 weeks and 6 weeks) to age (16 years and 18 years) to aerobic endurance athletes basketball beginners

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