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THE EFFECT OF LINEAR LOADING CIRCUIT TRAINING ON PHYSICAL FITNESS

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ABSTRACT

AIM: The purpose of this study was to examine the effect of linear loading circuit training towards physical fitness components which are cardio respiration endurance, anaerobic skill, agility, and the muscle power.

METHOD: This research used experimental method in which one group pre-test-posttest design was applied. The subject of high school students with its basketball extracurricular male students (age 16 until 18 years old). The sample amount of 30 students was taken randomly. Cardio respiration endurance instrument used Multi Stage Fitness Test, the anaerob skill used 20 meters sprint test, the agility used Illinoise test, and the legs muscle power used vertical jump test. The data analysis used statistical paired samples T test.

RESULTS: The research result shows $p < 0.005$ at cardio respiration endurance, anaerob skill, angility, and the muscle power.

CONCLUSION: Hence, it can be concluded that there is a positive effect of the circuit training with the enhancement of linear loading towards cardio respiration endurance, anaerob skill, agility, and the muscle power. This training program can be used to increase basketball extracurricular male students' physical fitness.

Key words : circuit training, endurance, anaerobic skill, agility, muscle power

I. INTRODUCTION

Developing talents and students' sports interest by high school was accommodated through sport extracurricular program. One of them is basketball. In order to develop talents in basketball, it needs a good physical fitness. The most important component of it in basketball is cardio respiration endurance, anaerob skill, angility, and the muscle power [1, 2]. Since basketball demands cardio respiration endurance, anaerobic skill, angility, and the muscle power to perform better during the match. A basketball player who has good cardio respiration endurance will have a quick recovery. A player who has good anaerobic skill will run straight faster to attack and to run back to maintain the ball. A player who has good agility will be easily changing the movement to defend and to kick the ball. Then, the player who has the muscle power (vertical jumping) which is one of the most explosive physical movement that is done in basketball especially in shooting by jumping (jump shoot) to get the score. Therefore, world coaches focus on arrange physical fitness program to increase the components of cardio respiration endurance, anaerobic skill (skill), agility, and the muscle power (vertical jump) of the players [3, 4].

The circuit training is one of linear loading resistance training method with progressive medium intensity designed to train and to increase cardio respiration endurance, anaerobic skill (speed), agility, and the legs muscle power [5]. Some research result of the training program with low and high intensity can increase cardio respiration endurance, anaerobic skill (speed), agility, and the legs muscle power [6]. Yet, the enhancement of circuit training loading is various. There is a circuit training program of the enhancement of linear and nonlinear loading [7] every week, every two weeks, and every three weeks. Smaller linear loading can risk an injury and overtraining is used on preparation phase rather than corrugated loading (undulatory) or nonlinear loading [8,9,10,11].

This is why this research aims to test to test the influence of circuit training of linear loading towards cardio respiration endurance, anaerobic skill (skill), agility, and the muscle power of basketball extracurricular high school students.

This research method used experimental method with one group pretest-posttest design. Dependent variable consists of cardio respiration endurance, anaerobic skill, agility, and the muscle power. Independent variable of linear loading circuit training program.

Research subject of physical students who joined basketball extracurricular were 30 students taken randomly.

The instrument of cardio respiration endurance used Multi Stage Fitness Test (MSFT), the formula to count MSFT was $VO_{2max} (mL/kg/min) = 0,38 \times \text{the total amount of complete load} + 25,98$ [12]. The instrument of gathered anaerobic skill data used 20 meter sprint. The instrument of gathered agility data used Illinois test. The instrument of gathered muscle power data used vertical jump test.

The data analysis used statistical paired samples T test with SPSS program.

The linear loading circuit training program consists of eight stations, they were shuttle run, sit up, jump rope, baks up, push up, plank, side defence, and squat trust. This circuit training was done in six weeks with three times training every week with low intensity. Each training was done three time circuits with three minute rest between circuits. On the first and second week, each station has 30 second activity with 60 second rest between stations. On the third and fourth week, each station has 40 second activity with 70 second rest between stations. While on the fifth and sixth week, each station has 50 second activity with 90 second rest between stations. Look at table 1 for the complete explanation.

Table 1. Linear Loading Circuit Training Program

.Week	Meeti ng	Circuit Activity (Distance between post 2 meters)	Intensity
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II. METHOD

be look in table 2 Paired Samples Statistics and table 3 Paired Samples Test as follows.

1-2	1-6	Pos	Physical activity	Time on (s)	Time off (s)	Circuit	Low
		1	Shuttle run	30	60	3 x / rest 3'	
		2	Sit up	30	60	3 x / rest 3'	
		3	Jump rope	30	60	3 x / rest 3'	
		4	Push up	30	60	3 x / rest 3'	
		5	Back up	30	60	3 x / rest 3'	
		6	plank	30	60	3 x / rest 3'	
		7	Slide defense	30	60	3 x / rest 3'	
8	Squat trust	30	60	3 x / rest 3'			
3-4	7-12	Pos	Physical activity	Time on (s)	Time off (s)	Circuit	Medium
		1	Shuttle run	40	70	3 x / rest 3'	
		2	Sit up	40	70	3 x / rest 3'	
		3	Jump rope	40	70	3 x / rest 3'	
		4	Push up	40	70	3 x / rest 3'	
		5	Back up	40	70	3 x / rest 3'	
		6	plank	40	70	3 x / rest 3'	
		7	Slide defense	40	70	3 x / rest 3'	
8	Squat trust	40	70	3 x / rest 3'			
5-6	13-18	Pos	Physical activity	Time on (s)	Time off (s)	Circuit	High
		1	Shuttle run	50	90	3 x / rest 3'	
		2	Sit up	50	90	3 x / rest 3'	
		3	Jump rope	50	90	3 x / rest 3'	
		4	Push up	50	90	3 x / rest 3'	
		5	Back up	50	90	3 x / rest 3'	
		6	plank	50	90	3 x / rest 3'	
		7	Slide defense	50	90	3 x / rest 3'	
8	Squat trust	50	90	3 x / rest 3'			

Table 2. Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
VO2maks.pre	40,3133	30	,63449	,11584
1 VO2maks.post	41,9867	30	,60898	,11118
Anarob.pre	3,6133	30	,19954	,03643
2 Anaerob.post	2,3400	30	,12205	,02228
Agility.pre	15,9033	30	1,04171	,19019
3 Agility.post	13,6233	30	,77668	,14180
Muscle Power.pre	39,2333	30	2,82456	,51569
4 Muscle Power.post	49,0000	30	4,39435	,80230

Table 3. Paired Samples Test

	Paired Differences				t	df	Sig. (2-tailed)	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence interval of the Difference				
				Lower				Upper
1 VO2maks.pre - VO2maks.post	1,67333	,59477	,10859	1,895	1,451	15,41	29	,000
2 Anarob.pre - Anaerob.post	1,27333	,17207	,03142	1,209	1,337	40,53	29	,000
3 Agility.pre - Agility.post	2,28000	,93011	,16981	1,932	2,627	13,42	29	,000
4 Muscle Power.pre - Muscle Power.post	9,76667	28721	,60016	10,99	8,539	16,27	29	,000

It can be seen that based on the paired samples statistics result on table 2, the average of VO2maks before was 40.31 and the average after was 41.98. The difference of VO2maks was statistically significant. It can be seen in table 3, t statistic 15.41 was bigger than t table 5 % = 2.042 or p < 0.05. Thus, there was a difference of VO2 before and after it was given a circuit training or VO2maks after given a circuit training was higher than before.

The anaerobic skill in table 2 showed that the average score before was 3.61 and the average after was 2.34. The difference of the anaerobic skill was statistically significant. It can be seen in table 3, t statistic 40.563 was bigger than t table 5 % = 2.042 or p < 0.05. Thus, there was a difference of anaerobic skill before and after it was given a circuit training or the time of anaerobic skill after given a circuit training was higher than before. The agility in table 2 showed that the average score before was 15.90 and the average after was 13.62.

III. RESULTS

The test result of cardio respiration endurance, anaerobic skill, agility, and the muscle power before and after it was given a circuit training for six weeks with oaired samples T test analysis can

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The difference of the anaerobic skill was statistically significant. It can be seen in table 3, t statistic was bigger than t table 5 % = 2.042 or $p < 0.05$. Thus, there was a difference of the anaerobic skill before and after it was given a circuit training or the time of anaerobic skill after given a circuit training was higher than before. The muscle power in table 2 showed that the average score before was 39.23 and the average after was 49.00. The difference of the anaerobic skill was statistically significant. It can be seen in table 3, t statistic 18.42 was bigger than t table 5 % = 2.042 or $p < 0.05$. Thus, there was a difference of anaerobic skill before and after it was given a circuit training or the time of anaerobic skill after given a circuit training was higher than before.

IV. DISCUSSION

This circuit training is an effective and economical training to increase physical components together in preparing the competition [13]. The training type of this circuit consists of several "stations". Each practice in station is determined by time. After the training is finished in one station, subjects move to the next station with specified time. The circuit finish after all practices are done [14]. This circuit training sessions combine resistance, rapidity, and intermission. Therefore, this research used circuits training of eight stations in which each station does shuttle run, sit up, jump rope, backs up, push up, plank, side defence dan squat thrust with its own body resistance. Each station is quickly done in 30 seconds with 60 second rest between stations on the first and second week. On the third and fourth week, the workload in each station is increased linearly in which each station is quickly done in 40 seconds with 70 second rest between station. So does on the fifth and sixth week, each station is increased linearly in which each station's activity is quickly done in 50 seconds with 90 second rest between stations. This matter is corresponding to several opinions which state that the circuit loading resistance training needs to be enhanced linearly so that it can increase cardio respiration endurance, anaerobic skill, agility, and the legs muscle power. Also, it can reduce the risk of injury [15].

This research shows that the circuit training with linear loading can increase VO_{2max} ($p < 0.05$), anaerobic skill ($p < 0.05$), agility ($p < 0.05$), and muscle power ($p < 0.05$). This matter is

corresponding to Taskin research [16] which states that circuits training can increase sprint-agility and anaerobic endurance. Besides that, it is also strengthened by the research result from Wirat Sonchan et.al [17] who shows that circuits training increases muscle power, agility, anaerobic endurance, and cardiovascular endurance.

V. CONCLUSION

Based on the research result and the discussion, it can be concluded that circuit training of linear loading has a positive effect towards cardio respiration endurance (VO_{2max}), anaerobic skill, agility, and the muscle power for high school basketball extracurricular male students. Therefore, circuit training of linear loading can be used by teachers or coaches in basketball of male players to increase their physical fitness.

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