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Impact of Circuit Training Variations on Muscle Endurance, Cardiovascular Endurance, and Decreased Body Fat

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Abstract

In the modern era like today, the tight schedule of matches makes physical trainers have to mix programs in such a way as to prepare their athletes for maximum performance, often not enough time is available to develop each of these elements optimally. The purpose of this study was to determine whether there was a significant difference between SR-Circuit Training and SO-Circuit Training on muscle endurance, cardiovascular endurance, and decreased body fat. The research method used in this research is the experimental method. This method is used on the basis of the consideration that the nature of experimental research is to try something to determine the effect of a treatment or treatment. The results showed that there was a significant difference between SR-Circuit Training and SO-Circuit Training on muscle endurance, cardiovascular endurance, and decreased body fat.

Keywords
circuit training; muscle endurance; cardiovascular endurance; loss of body fat

I. Introduction

In the modern era like today, the tight schedule of matches makes physical coaches have to formulate programs in such a way as to prepare their athletes for maximum performance, often there is not enough time to develop each of these elements optimally. However, often the time available to prepare athletes physically ahead of a game is only 1-2 months. Therefore, if the available time is too short, it is necessary to strive or find a training system that is good enough and can guarantee that athletes are in good physical condition to face the competition, a physical condition training system that can be used for this purpose is a system called circuit training. Circuit training is an exercise system that can develop simultaneously the overall fitness of the body (Harsono, 2018). Is also revealed in a 2019 study that showed an increase in the components of muscular endurance and endurance of field tennis athletes (Anandiaz, 2019). Organization must have a goal to be achieved by the organizational members (Niati et al., 2021). The success of leadership is partly determined by the ability of leaders to develop their organizational culture. (Arif, 2019).

In the era of the increasingly modern field tennis game now every player must have equally good attacking and defensive abilities. To be able to attack and defend equally well, every player must have the ability to have a good physical condition, especially if you want to become a professional field tennis player. Good movement is one thing that tennis players are very critical to have. Successful tennis players must always place the body quickly and hit well, as is known, the sport of field tennis is a sport whose characteristics change such as running short to the side, changing direction many times (Kovacs, 2011) Good movements or not this is also greatly influenced by the body composition of each tennis athlete himself, athletes who have high enough fat levels will

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make movements slow down and inefficient. This high-fat content also increases the risk of high injury (Martinez-Rodriguez et al., 2015).

Therefore, all field tennis players are required to have good physical conditions. Physical condition plays a very important role in efforts to achieve maximum achievements because the physical condition is considered a basic factor for a tennis player, as revealed by Harsono:

If the physical condition is good then, 1). There will be an increase in the number of capillaries to help (serve) muscle fibers thereby improving blood flow; 2). There will be an increase in the elements of cardiovascular endurance, muscle strength, joint flexibility, stamina, and speed so an athlete will not easily feel tired; 3). There will be a better economy of motion at practice time; 4). There will be a faster recovery in organ organs of the body after exercise; 5). There will be a rapid response from our body organisms if at any time such a response is required; 6). Able to practice technical and tactical skills longer and better; 7). Will experience less pain (soreness) in muscles, joints, and tendons; 8). Avoidance of mental fatigue; 9). Better self-confidence because he feels physically better prepared.

Based on the above, there are many advantages if a tennis player has the good physical condition. Elements of physical condition that must be considered are muscle endurance, cardiovascular endurance, and fat levels. Muscular endurance is the ability of muscles to contract to the stimuli of a prisoner for a long time.

Table 1. The main goals of strength training in tennis

Basic Strength:	+++
1. Muscular Balance	
2. Injury Prevention	
Maximum Strength:	++
1. Hypertrophy	
2. Neuromuscular Adaptations	
3. Intramuscular Coordination	
Muscular Power	++++
Muscular Endurance	++++

Note: number of + symbols indicates the importance of the goal

The importance of this muscular endurance can see where there is often the case in one match of a player whose strokes are heavy in the initial set, but a decrease in the last set. This clearly illustrates that the endurance of the player's arm muscles is not trained enough because they are no longer able to hit heavily. So the muscular endurance of a tennis player plays an important role in matches where when players compete, they can show the same quality of strokes in set 5 with set 1.

Meanwhile, cardiovascular endurance or commonly referred to as VO2max is the body's ability to work for a long time without experiencing excessive fatigue after completing the work. In a field tennis match, the game lasts quite a long time, namely for 3-5 sets and the duration is often more than 2 hours (Reid & Schneiker, 2008) so every player is required to show good technical qualities during play, meaning that muscle endurance and cardiovascular endurance are important factors in fighting fatigue while playing and variables that make a tennis player quickly recover the state of the body to go to high performance during training or matches(Genevois, 2019). Therefore a trainer must form aerobic and anaerobic power.

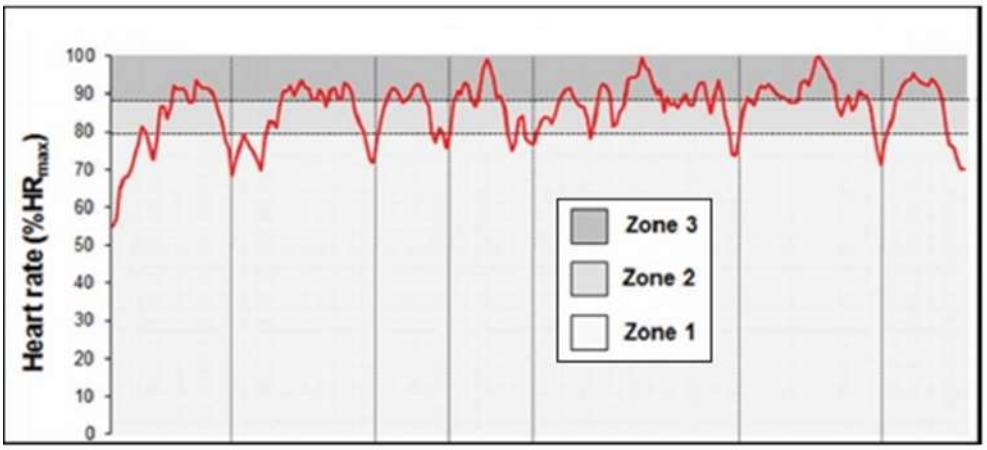

Figure 1. *HR variation during tennis match play (adapted from Baiget et al, 2015)*

If referring to the discussion above, muscular endurance and cardiovascular endurance are very important in sports that demand achievement, especially in the field of tennis sport where each player in one match is required to show good technical qualities for 3-5 sets or with a duration of about more than 1-2 hours with the characteristics of a game that lasts with a high intensity of short duration (4-10 seconds) and repeatedly with break 10-20 seconds (Hoppe et al, 2014). However, the physical parameters above the weak are also determined by non-optimal fat levels, therefore in terms of fat levels, it is also very important for a tennis athlete to have optimal levels. Many exercise methods can be used to increase muscle endurance and cardiovascular endurance. Among them are *set systems* to increase muscle endurance and *intervals* to increase cardiovascular endurance.

The purpose of this study is to find out whether there are significant differences in SR-Circuit Training and SO-Circuit Training exercises on muscle endurance and to find out whether there are significant differences between SR-Circuit Training and SO-Circuit Training exercises on cardiovascular endurance and u to find out if there is a significant difference in SR-Circuit Training and SO-Circuit Training exercises on body fat loss.

II. Research Method

In a research method, it is necessary to establish a method that is appropriate and can help reveal a problem. The method in a study is a way that must be taken to achieve the goal, while in a study it is to reveal, describe and collect the results of problem-solving in certain ways by the procedures commonly used including historical, descriptive, and experimental.

The research method used in this study is experimental. This method is used based on the consideration that the nature of experimental research is to try something to find out the effect of the consequences of a treatment or treatment as mentioned (Frankael, 2011). In addition, the author wants to know the influence of free variables on the bound variables investigated or observed. Regarding this experimental method, Sugiyono stated that: "The experimental method can be interpreted as a research method used to find the influence of certain treatments on others under controlled conditions" (Sugiyono, 2012).

III. Result and Discussion

Data analysis is divided into two, namely descriptive analysis and comparative test analysis (comparative) to determine the effect of comparative variations in circuit training exercises on muscle endurance, cardiovascular endurance, and fat loss of junior field tennis athletes. The total sample that was subjected to this study was 5 people in each group. The first group was the one that used the SR-Circuit exercise, the second group used the SO-Circuit exercise, and group 3 was the control group.

3.1 Output SPSS

Means

Report

Group		Push Up Pre	Push Up Post	Sit Up Pre	Sit Up Post	Squat Jump Pre	Squat Jump Post
SR-Circuit Training	Mean	33.8000	39.8000	42.8000	46.8000	46.4000	51.6000
	Std. Deviation	12.02913	12.63725	9.60208	9.60208	12.66096	11.01363
	Median	31.0000	37.0000	41.0000	45.0000	51.0000	56.0000
	Minimum	21.00	28.00	30.00	35.00	32.00	39.00
	Maximum	53.00	59.00	55.00	58.00	60.00	64.00
SO-Circuit Training	Mean	16.8000	23.6000	31.4000	40.0000	29.2000	37.6000
	Std. Deviation	9.93479	12.23928	4.61519	5.91608	8.67179	8.73499
	Median	14.0000	21.0000	31.0000	39.0000	31.0000	38.0000
	Minimum	8.00	13.00	26.00	33.00	15.00	24.00
	Maximum	32.00	42.00	37.00	47.00	37.00	47.00
Control	Mean	27.6000	30.4000	41.2000	42.6000	38.4000	40.2000
	Std. Deviation	7.70065	8.17313	5.26308	5.72713	4.92950	6.22093
	Median	30.0000	32.0000	40.0000	42.0000	38.0000	41.0000
	Minimum	15.00	18.00	35.00	35.00	32.00	33.00
	Maximum	34.00	40.00	48.00	50.00	45.00	48.00
Total	Mean	26.0667	31.2667	38.4667	43.1333	38.0000	43.1333
	Std. Deviation	11.80476	12.44110	8.21903	7.35689	11.27576	10.35006
	Median	28.0000	30.0000	38.0000	42.0000	36.0000	41.0000
	Minimum	8.00	13.00	26.00	33.00	15.00	24.00
	Maximum	53.00	59.00	55.00	58.00	60.00	64.00

Means

Report

Group		Vo2Max Pre	Vo2Max Post	Pre Fat Content	Post Fat Content
SR-Circuit Training	Mean	47.5600	53.8820	18.0600	14.4940
	Std. Deviation	7.69955	6.45418	4.56432	2.29993

	Median	50.8000	57.1000	17.5000	14.1700
	Minimum	34.60	43.80	13.40	12.10
	Maximum	53.50	59.13	22.80	17.20
SO-Circuit Training	Mean	38.1400	42.4920	18.9560	18.2880
	Std. Deviation	6.77739	6.80005	6.23239	5.84438
	Median	38.3000	43.5900	16.9800	16.7000
	Minimum	30.50	35.07	11.30	12.54
	Maximum	47.80	51.20	26.10	24.80
Control	Mean	45.8400	45.5860	17.3340	17.8440
	Std. Deviation	6.54240	6.60178	5.24626	4.94193
	Median	50.2000	49.5000	18.5100	19.3200
	Minimum	38.10	36.60	8.90	10.10
	Maximum	51.20	51.30	22.70	22.30
Total	Mean	43.8467	47.3200	18.1167	16.8753
	Std. Deviation	7.76309	7.89576	5.03840	4.61751
	Median	46.6000	49.5000	17.5000	16.5000
	Minimum	30.50	35.07	8.90	10.10
	Maximum	53.50	59.13	26.10	24.80

Explore Group

Tests of Normality

	Group	Shapiro-Wilk		
		Statistic	df	Itself.
Push Up Pre	SR-Circuit Training	.930	5	.595
	SO-Circuit Training	.900	5	.409
	Control	.864	5	.244
Push Up Post	SR-Circuit Training	.919	5	.521
	SO-Circuit Training	.893	5	.374
	Control	.967	5	.852
Sit Up Pre	SR-Circuit Training	.982	5	.945
	SO-Circuit Training	.951	5	.743
	Control	.963	5	.829
Sit Up Post	SR-Circuit Training	.945	5	.699
	SO-Circuit Training	.941	5	.672
	Control	.994	5	.991
Squat Jump Pre	SR-Circuit Training	.874	5	.285
	SO-Circuit Training	.885	5	.330
	Control	.998	5	.998
Squat Jump Post	SR-Circuit Training	.885	5	.331
	SO-Circuit Training	.944	5	.696
	Control	.952	5	.754
Vo2Max Pre	SR-Circuit Training	.819	5	.115
	SO-Circuit Training	.971	5	.882

	Control	.757	5	.065
Vo2Max Post	SR-Circuit Training	.853	5	.204
	SO-Circuit Training	.933	5	.615
	Control	.836	5	.153
Pre Fat Content	SR-Circuit Training	.841	5	.168
	SO-Circuit Training	.921	5	.535
	Control	.922	5	.543
Post Fat Content	SR-Circuit Training	.896	5	.390
	SO-Circuit Training	.847	5	.184
	Control	.902	5	.422

T-Test (SR-Circuit Training)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Push Up Pre	33.8000	5	12.02913	5.37959
	Push Up Post	39.8000	5	12.63725	5.65155
Pair 2	Sit Up Pre	42.8000	5	9.60208	4.29418
	Sit Up Post	46.8000	5	9.60208	4.29418
Pair 3	Squat Jump Pre	46.4000	5	12.66096	5.66216
	Squat Jump Post	51.6000	5	11.01363	4.92544
Pair 4	Vo2MaxPre	47.5600	5	7.69955	3.44334
	Vo2MaxPost	53.8820	5	6.45418	2.88640
Pair 5	Pre Fat Content	18.0600	5	4.56432	2.04123
	Post Fat Content	14.4940	5	2.29993	1.02856

Paired Samples Correlations

		N	Correlation	Itself.
Pair 1	Push Up Pre & Push Up Post	5	.980	.003
Pair 2	Sit Up Pre & Sit Up Post	5	.986	.002
Pair 3	Squat Jump Pre & Squat Jump Post	5	.998	.000
Pair 4	Vo2MaxPre & Vo2MaxPost	5	.976	.004
Pair 5	Pre Fat Content & Post Fat Content	5	.995	.000

Paired Samples Test

		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	Push Up Pre – Push Up Post	-6.00000	2.54951	1.14018	-9.16563	-2.83437	-5.262	4	.006
Pair 2	Sit Up Pre – Sit Up Post	-4.00000	1.58114	.70711	-5.96324	-2.03676	-5.657	4	.005

Pair 3	Squat Jump Pre – Squat Jump Post	-5.20000	1.78885	.80000	-7.42116	-2.97884	-6.500	4	.003
Pair 4	Vo2Max Pre - Vo2Max Post	-6.32200	1.98361	.88710	-8.78498	-3.85902	-7.127	4	.002
Pair 5	Pre Fat Content – Post Fat Content	3.56600	2.28895	1.02365	.72390	6.40810	3.484	4	.025

T-Test (SO-Circuit Training)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Push Up Pre	16.8000	5	9.93479	4.44297
	Push Up Post	23.6000	5	12.23928	5.47357
Pair 2	Sit Up Pre	31.4000	5	4.61519	2.06398
	Sit Up Post	40.0000	5	5.91608	2.64575
Pair 3	Squat Jump Pre	29.2000	5	8.67179	3.87814
	Squat Jump Post	37.6000	5	8.73499	3.90640
Pair 4	Vo2Max Pre	38.1400	5	6.77739	3.03094
	Vo2Max Post	42.4920	5	6.80005	3.04107
Pair 5	Pre Fat Content	18.9560	5	6.23239	2.78721
	Post Fat Content	18.2880	5	5.84438	2.61368

Paired Samples Correlations

		N	Correlation	Itself.
Pair 1	Push Up Pre & Push Up Post	5	.998	.000
Pair 2	Sit Up Pre & Sit Up Post	5	.998	.000
Pair 3	Squat Jump Pre & Squat Jump Post	5	.991	.001
Pair 4	Vo2Max Pre & Vo2Max Post	5	.950	.013
Pair 5	Pre Fat Content & Post Fat Content	5	.976	.004

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Push Up Pre – Push Up Post	-6.80000	2.38747	1.06771	-9.76443	-3.83557	-6.369	4	.003

Pair 2	Sit Up Pre – Sit Up Post	-8.60000	1.34164	.60000	-10.26587	-6.93413	-14.333	4	.000
Pair 3	Squat Jump Pre – Squat Jump Post	-8.40000	1.14018	.50990	-9.81571	-6.98429	-16.474	4	.000
Pair 4	Vo2Max Pre - Vo2Max Post	-4.35200	2.15589	.96414	-7.02889	-1.67511	-4.514	4	.011
Pair 5	Pre Fat Content – Post Fat Content	.66800	1.37612	.61542	-1.04068	2.37668	1.085	4	.339

T-Test (Control)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Push Up Pre	27.6000	5	7.70065	3.44384
	Push Up Post	30.4000	5	8.17313	3.65513
Pair 2	Sit Up Pre	41.2000	5	5.26308	2.35372
	Sit Up Post	42.6000	5	5.72713	2.56125
Pair 3	Squat Jump Pre	38.4000	5	4.92950	2.20454
	Squat Jump Post	40.2000	5	6.22093	2.78209
Pair 4	Vo2Max Pre	45.8400	5	6.54240	2.92585
	Vo2Max Post	45.5860	5	6.60178	2.95241
Pair 5	Pre Fat Content	17.3340	5	5.24626	2.34620
	Post Fat Content	17.8440	5	4.94193	2.21010

Paired Samples Correlations

		N	Correlation	Itself.
Pair 1	Push Up Pre & Push Up Post	5	.972	.005
Pair 2	Sit Up Pre & Sit Up Post	5	.990	.001
Pair 3	Squat Jump Pre & Squat Jump Post	5	.975	.005
Pair 4	Vo2Max Pre & Vo2Max Post	5	.983	.003
Pair 5	Pre Fat Content & Post Fat Content	5	.967	.007

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Push Up Pre – Push Up Post	-2.80000	1.92354	.86023	-5.18839	-.41161	-3.255	4	.031
Pair 2	Sit Up Pre – Sit Up Post	-1.40000	.89443	.40000	-2.51058	-.28942	-3.500	4	.025
Pair 3	Squat Jump Pre – Squat Jump Post	-1.80000	1.78885	.80000	-4.02116	.42116	-2.250	4	.088
Pair 4	Vo2Max Pre - Vo2Max Post	.25400	1.22845	.54938	-1.27132	1.77932	.462	4	.668
Pair 5	Pre Fat Content – Post Fat Content	-.51000	1.34203	.60017	-2.17635	1.15635	-.850	4	.443

Oneway

ANOVA

		Sum of Squares	df	Mean Square	F	Itself.
Push Up Pre	Between Groups	740.133	2	370.067	3.668	.057
	Within Groups	1210.800	12	100.900		
	Total	1950.933	14			
Push Up Post	Between Groups	661.733	2	330.867	2.638	.112
	Within Groups	1505.200	12	125.433		
	Total	2166.933	14			
Sit Up Pre	Between Groups	380.933	2	190.467	4.047	.045
	Within Groups	564.800	12	47.067		
	Total	945.733	14			
Sit Up Post	Between Groups	117.733	2	58.867	1.104	.363
	Within Groups	640.000	12	53.333		
	Total	757.733	14			
Squat Jump Pre	Between Groups	740.800	2	370.400	4.277	.040
	Within Groups	1039.200	12	86.600		
	Total	1780.000	14			

Squat Jump Post	Between Groups	554.533	2	277.267	3.520	.063
	Within Groups	945.200	12	78.767		
	Total	1499.733	14			
Vo2Max Pre	Between Groups	251.641	2	125.821	2.550	.119
	Within Groups	592.076	12	49.340		
	Total	843.717	14			
Vo2Max Post	Between Groups	346.881	2	173.440	3.957	.048
	Within Groups	525.922	12	43.827		
	Total	872.803	14			
Pre Fat Content	Between Groups	6.601	2	3.301	.114	.894
	Within Groups	348.796	12	29.066		
	Total	355.397	14			
Post Fat Content	Between Groups	43.023	2	21.512	1.010	.393
	Within Groups	255.476	12	21.290		
	Total	298.500	14			

Post Hoc Tests

Multiple Comparisons

LSD

Dependent Variable	(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Itself.	95% Confidence Interval	
						Lower Bound	Upper Bound
Push Up Pre	SR-Circuit Training	SO-Circuit Training	17.00000*	6.35295	.020	3.1581	30.8419
		Control	6.20000	6.35295	.348	-7.6419	20.0419
	SO-Circuit Training	SR-Circuit Training	-17.00000*	6.35295	.020	-30.8419	-3.1581
		Control	-10.80000	6.35295	.115	-24.6419	3.0419
	Control	SR-Circuit Training	-6.20000	6.35295	.348	-20.0419	7.6419
		SO-Circuit Training	10.80000	6.35295	.115	-3.0419	24.6419
Push Up Post	SR-Circuit Training	SO-Circuit Training	16.20000*	7.08331	.041	.7668	31.6332
		Control	9.40000	7.08331	.209	-6.0332	24.8332
	SO-Circuit Training	SR-Circuit Training	-16.20000*	7.08331	.041	-31.6332	-.7668

		Control	-6.80000	7.08331	.356	-22.2332	8.6332
	Control	SR-Circuit Training	-9.40000	7.08331	.209	-24.8332	6.0332
		SO-Circuit Training	6.80000	7.08331	.356	-8.6332	22.2332
Sit Up Pre	SR-Circuit Training	SO-Circuit Training	11.40000*	4.33897	.022	1.9462	20.8538
		Control	1.60000	4.33897	.719	-7.8538	11.0538
	SO-Circuit Training	SR-Circuit Training	-11.40000*	4.33897	.022	-20.8538	-1.9462
		Control	-9.80000*	4.33897	.043	-19.2538	-.3462
	Control	SR-Circuit Training	-1.60000	4.33897	.719	-11.0538	7.8538
		SO-Circuit Training	9.80000*	4.33897	.043	.3462	19.2538
Sit Up Post	SR-Circuit Training	SO-Circuit Training	6.80000	4.61880	.167	-3.2635	16.8635
		Control	4.20000	4.61880	.381	-5.8635	14.2635
	SO-Circuit Training	SR-Circuit Training	-6.80000	4.61880	.167	-16.8635	3.2635
		Control	-2.60000	4.61880	.584	-12.6635	7.4635
	Control	SR-Circuit Training	-4.20000	4.61880	.381	-14.2635	5.8635
		SO-Circuit Training	2.60000	4.61880	.584	-7.4635	12.6635
Squat Jump Pre	SR-Circuit Training	SO-Circuit Training	17.20000*	5.88558	.013	4.3764	30.0236
		Control	8.00000	5.88558	.199	-4.8236	20.8236
	SO-Circuit Training	SR-Circuit Training	-17.20000*	5.88558	.013	-30.0236	-4.3764
		Control	-9.20000	5.88558	.144	-22.0236	3.6236
	Control	SR-Circuit Training	-8.00000	5.88558	.199	-20.8236	4.8236
		SO-Circuit Training	9.20000	5.88558	.144	-3.6236	22.0236
Squat Jump Post	SR-Circuit Training	SO-Circuit Training	14.00000*	5.61308	.028	1.7701	26.2299
		Control	11.40000	5.61308	.065	-.8299	23.6299
	SO-Circuit Training	SR-Circuit Training	-14.00000*	5.61308	.028	-26.2299	-1.7701

		Control	-2.60000	5.61308	.652	-14.8299	9.6299
	Control	SR-Circuit Training	-11.40000	5.61308	.065	-23.6299	.8299
		SO-Circuit Training	2.60000	5.61308	.652	-9.6299	14.8299
Vo2Max Pre	SR-Circuit Training	SO-Circuit Training	9.42000	4.44251	.055	-.2594	19.0994
		Control	1.72000	4.44251	.705	-7.9594	11.3994
	SO-Circuit Training	SR-Circuit Training	-9.42000	4.44251	.055	-19.0994	.2594
		Control	-7.70000	4.44251	.109	-17.3794	1.9794
	Control	SR-Circuit Training	-1.72000	4.44251	.705	-11.3994	7.9594
		SO-Circuit Training	7.70000	4.44251	.109	-1.9794	17.3794
Vo2Max Post	SR-Circuit Training	SO-Circuit Training	11.39000*	4.18697	.019	2.2674	20.5126
		Control	8.29600	4.18697	.071	-.8266	17.4186
	SO-Circuit Training	SR-Circuit Training	-11.39000*	4.18697	.019	-20.5126	-2.2674
		Control	-3.09400	4.18697	.474	-12.2166	6.0286
	Control	SR-Circuit Training	-8.29600	4.18697	.071	-17.4186	.8266
		SO-Circuit Training	3.09400	4.18697	.474	-6.0286	12.2166
Pre Fat Content	SR-Circuit Training	SO-Circuit Training	-.89600	3.40977	.797	-8.3252	6.5332
		Control	.72600	3.40977	.835	-6.7032	8.1552
	SO-Circuit Training	SR-Circuit Training	.89600	3.40977	.797	-6.5332	8.3252
		Control	1.62200	3.40977	.643	-5.8072	9.0512
	Control	SR-Circuit Training	-.72600	3.40977	.835	-8.1552	6.7032
		SO-Circuit Training	-1.62200	3.40977	.643	-9.0512	5.8072
Post Fat Content	SR-Circuit Training	SO-Circuit Training	-3.79400	2.91820	.218	-10.1522	2.5642
		Control	-3.35000	2.91820	.273	-9.7082	3.0082
	SO-Circuit Training	SR-Circuit Training	3.79400	2.91820	.218	-2.5642	10.1522

		Control	.44400	2.91820	.882	-5.9142	6.8022
	Control	SR-Circuit Training	3.35000	2.91820	.273	-3.0082	9.7082
		SO-Circuit Training	-.44400	2.91820	.882	-6.8022	5.9142

*. The mean difference is significant at the 0.05 level.

Means

Report

Group		Pushup Difference	SitUp Difference	Selisih Squat Jump	Vo2Max Difference	Difference in Fat Content
SR-Circuit Training	Mean	6.0000	4.0000	5.2000	6.3220	3.5660
	Std. Deviation	2.54951	1.58114	1.78885	1.98361	2.28895
	Median	6.0000	4.0000	5.0000	5.6300	3.3300
	Minimum	2.00	2.00	3.00	4.50	1.30
	Maximum	9.00	6.00	7.00	9.20	6.20
SO-Circuit Training	Mean	6.8000	8.6000	8.4000	4.3520	.6680
	Std. Deviation	2.38747	1.34164	1.14018	2.15589	1.37612
	Median	7.0000	8.0000	8.0000	3.4000	.5000
	Minimum	4.00	7.00	7.00	2.69	-1.24
	Maximum	10.00	10.00	10.00	8.00	2.50
Control	Mean	2.8000	1.4000	1.8000	-.2540	-.5100
	Std. Deviation	1.92354	.89443	1.78885	1.22845	1.34203
	Median	2.0000	2.0000	3.0000	-.7000	-.8100
	Minimum	1.00	.00	-1.00	-1.50	-2.15
	Maximum	6.00	2.00	3.00	1.20	1.30
Total	Mean	5.2000	4.6667	5.1333	3.4733	1.2413
	Std. Deviation	2.78260	3.30944	3.15926	3.31949	2.38651
	Median	6.0000	4.0000	5.0000	3.4000	1.3000
	Minimum	1.00	.00	-1.00	-1.50	-2.15
	Maximum	10.00	10.00	10.00	9.20	6.20

Oneway

ANOVA

		Sum of Squares	df	Mean Square	F	Itself.
Pushup Difference	Between Groups	44.800	2	22.400	4.226	.041
	Within Groups	63.600	12	5.300		
	Total	108.400	14			

SitUp Difference	Between Groups	132.933	2	66.467	39.098	.000
	Within Groups	20.400	12	1.700		
	Total	153.333	14			
Squats DifferenceJump	Between Groups	108.933	2	54.467	21.221	.000
	Within Groups	30.800	12	2.567		
	Total	139.733	14			
Vo2Max Difference	Between Groups	113.900	2	56.950	16.930	.000
	Within Groups	40.367	12	3.364		
	Total	154.267	14			
Difference in Fat Content	Between Groups	44.000	2	22.000	7.387	.008
	Within Groups	35.736	12	2.978		
	Total	79.736	14			

Post Hoc Tests

Multiple Comparisons

LSD

Dependent Variable	(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Itself.	95% Confidence Interval	
						Lower Bound	Upper Bound
Pushup Difference	SR-Circuit Training	SO-Circuit Training	-.80000	1.45602	.593	-3.9724	2.3724
		Control	3.20000*	1.45602	.048	.0276	6.3724
	SO-Circuit Training	SR-Circuit Training	.80000	1.45602	.593	-2.3724	3.9724
		Control	4.00000*	1.45602	.018	.8276	7.1724
	Control	SR-Circuit Training	-3.20000*	1.45602	.048	-6.3724	-.0276
		SO-Circuit Training	-4.00000*	1.45602	.018	-7.1724	-.8276
SitUp Difference	SR-Circuit Training	SO-Circuit Training	-4.60000*	.82462	.000	-6.3967	-2.8033
		Control	2.60000*	.82462	.008	.8033	4.3967
	SO-Circuit Training	SR-Circuit Training	4.60000*	.82462	.000	2.8033	6.3967
		Control	7.20000*	.82462	.000	5.4033	8.9967

	Control	SR-Circuit Training	-2.60000*	.82462	.008	-4.3967	-.8033
		SO-Circuit Training	-7.20000*	.82462	.000	-8.9967	-5.4033
Squats DifferenceJump	SR-Circuit Training	SO-Circuit Training	-3.20000*	1.01325	.008	-5.4077	-.9923
		Control	3.40000*	1.01325	.006	1.1923	5.6077
	SO-Circuit Training	SR-Circuit Training	3.20000*	1.01325	.008	.9923	5.4077
		Control	6.60000*	1.01325	.000	4.3923	8.8077
	Control	SR-Circuit Training	-3.40000*	1.01325	.006	-5.6077	-1.1923
		SO-Circuit Training	-6.60000*	1.01325	.000	-8.8077	-4.3923
Vo2Max Difference	SR-Circuit Training	SO-Circuit Training	1.97000	1.15998	.115	-.5574	4.4974
		Control	6.57600*	1.15998	.000	4.0486	9.1034
	SO-Circuit Training	SR-Circuit Training	-1.97000	1.15998	.115	-4.4974	.5574
		Control	4.60600*	1.15998	.002	2.0786	7.1334
	Control	SR-Circuit Training	-6.57600*	1.15998	.000	-9.1034	-4.0486
		SO-Circuit Training	-4.60600*	1.15998	.002	-7.1334	-2.0786
Difference in Fat Content	SR-Circuit Training	SO-Circuit Training	2.89800*	1.09142	.021	.5200	5.2760
		Control	4.07600*	1.09142	.003	1.6980	6.4540
	SO-Circuit Training	SR-Circuit Training	-2.89800*	1.09142	.021	-5.2760	-.5200
		Control	1.17800	1.09142	.302	-1.2000	3.5560
	Control	SR-Circuit Training	-4.07600*	1.09142	.003	-6.4540	-1.6980
		SO-Circuit Training	-1.17800	1.09142	.302	-3.5560	1.2000

3.2 Analysis Results

a. Descriptive Analysis

This analysis is used to find out an overview of research data. This analysis is in the form of average values, standard deviations, the largest values, and the smallest values in each group. The following is an overview of the results of muscle endurance, cardiovascular endurance, and fat levels of field tennis athletes using SR- Circuit training and SO-Circuit training exercises.

Table 2. An Overview of the Muscular Endurance of Field Tennis Athletes

Muscular Endurance	SR-Circuit Training	SO-Circuit Training	Control
	n=5	n=5	n=5
Push Up			
Initial Test			
Mean±SD	33.8±12.0	16.8±9.9	27.6±7.7
Median (Min-Max)	31.0 (21.0-53.0)	14.0 (8.0-32.0)	30.0 (15.0-34.0)
Final Test			
Mean±SD	39.8±12.6	23.6±12.2	30.4±8.2
Median (Min-Max)	37.0 (28.0-59.0)	21.0 (26.0-37.0)	32.0 (18.0-48.0)
Difference			
Mean±SD	6.0±2.5	6.8±2.4	2.8±1.9
Median (Min-Max)	6.0 (2.0-9.0)	7.0 (4.0-10.0)	2.0 (1.0-6.0)
Sit Up			
Initial Test			
Mean±SD	42.8±9.6	31.4±4.6	41.2±5.3
Median (Min-Max)	41.0 (30.0-55.0)	31.0 (26.0-37.0)	40.0 (35.0-48.0)
Final Test			
Mean±SD	46.8±9.6	40.0±5.9	42.6±5.7
Median (Min-Max)	45.0 (35.0-58.0)	39.0 (33.0-47.0)	42.0 (35.0-50.0)
Difference			
Mean±SD	4.0±1.6	8.6±1.3	1.4±0.9
Median (Min-Max)	4.0 (2.0-6.0)	8.0 (7.0-10.0)	2.0 (0.0-2.0)
Squat Jump			
Initial Test			
Mean±SD	46.4±12.7	29.2±8.7	38.4±4.9
Median (Min-Max)	51.0 (32.0-60.0)	31.0 (15.0-37.0)	38.0 (32.0-45.0)
Final Test			
Mean±SD	51.6±11.0	37.6±8.7	40.2±6.2
Median (Min-Max)	56.0 (39.0-64.0)	38.0 (24.0-47.0)	41.0 (33.0-48.0)
Difference			
Mean±SD	5.2±1.8	8.4±1.1	1.8±1.8
Median (Min-Max)	5.0 (3.0-7.0)	8.0 (7.0-10.0)	3.0 (-1.0-3.0)

Source: Research Data, 2022

Based on the table above, you can see an overview of the endurance of the court tennis muscles tested by doing push-ups, sit-ups, and squat jumps. When conducting the initial push-up test for the SR-Circuit Training group, it received a mean score of 33.8± 12.0 with a minimum value of 21.0 and a maximum of 53.0, while in the SO-Circuit Training group it got a mean score of 16.8± 9.9 with a minimum value of 8.0 and a maximum of 32.0, and in the control group, it got a mean score of 27.6± 7.7 with a minimum value of 15.0 and a maximum of 34.0. when viewed from the mean value in the initial test of push-up exercises, the mean value of SR-Circuit Training is greater than Dick and the control group is greater than SO-Circuit Training and (SR >Control>SO). Then in the final test, push-up training in the SR-Circuit Training group got a mean score of 39.8± 12.6 with a minimum score of 28.0 and a maximum of 59.0, while the SO-Circuit Training group got a mean score of 23.6± 12.2 with a minimum value of 26.0 and a maximum of 37.0, and in the control group got a mean score of 30.4± 8.2 with a minimum score of 18.0 and a maximum of 48.0. when viewed from the mean value in the final test of push-up exercises, the mean value of SR-Circuit Training is greater than Dick and the control group is greater than SO-Circuit Training and (SR >Control>SO). If you compare the mean values in the initial test and the final test on push-up exercises, there is a difference in the increase in scores in each group. The SR-Circuit Training group had an increased mean value of 6.0, while in the SO-Circuit Training group the mean value increased by 6.8, and in the control group, the mean value increased by 2.8.

Table 3. Cardiovascular Endurance Overview of Field Tennis Athletes

Bleep Test	SR-Circuit Training	SO-Circuit Training	Control
	n=5	n=5	n=5
Initial Test			
Mean±SD	47.6±7.7	38.1±6.8	45.8±6.5
Median (Min-Max)	50.8 (34.6-53.5)	38.3 (30.5-47.8)	50.2 (38.1-51.2)
Final Test			
Mean±SD	53.9±6.5	42.5±6.8	45.6±6.6
Median (Min-Max)	57.1 (43.8-59.1)	43.6 (35.1-51.2)	49.5 (36.6-51.3)
Difference			
Mean±SD	6.3±2.0	4.4±2.2	-0.3±1.2
Median (Min-Max)	5.6 (4.5-9.2)	3.4 (2.7-8.0)	-0.7 (-1.5-1.2)

Source: Research Data, 2022

Based on the table above, you can see a picture of the cardiovascular endurance of field tennis athletes with a bleep test. When conducting the initial test, the bleep test for the SR-Circuit Training group got a mean score of 47.6± 7.7 with a minimum value of 34.6 and a maximum of 53.5, while in the SO-Circuit Training group it got a mean score of 38.1± 6.8 with a minimum value of 30.5 and a maximum of 47.8, and in the control group, it got a mean score of 45.8±6.5 with a minimum value of 38.1 and a maximum of 51.2. When viewed from the mean value in the initial test on the bleep test, the mean value of SR-Circuit Training is greater than the dick group and the control group is greater than so-circuit training and (SR >Control>SO). Then in the final test, the bleep test in the SR-Circuit Training group got a mean score of 53.9±6.5 with a minimum value of 43.8 and a

maximum of 59.1, while the SO-Circuit Training group got a mean score of 42.5±6.8 with a minimum score of 35.1 and a maximum of 51.2, and in the control group got a mean score of 45.6±6.6 with a minimum score of 36.6 and a maximum of 51.3. When viewed from the mean value in the final test bleep test, the mean value of SR-Circuit Training is greater than the dick group and the control group is greater than SO-Circuit Training and (SR >Control>SO). When comparing the mean values in the initial test and the final test on the Bleep test, there was a difference in the increase in scores in the SR-Circuit training and SO-Circuit training groups while in the control group there was a decrease. The SR-Circuit Training group had an increased mean value of 6.3, while in the SO-Circuit Training group the mean value increased by 4.4, and in the control group, the mean value decreased by 0.3.

Table 4. Overview of Fat Levels of Field Tennis Athletes

Fat Content (%)	SR-Circuit Training	SO-Circuit Training	Control
	n=5	n=5	n=5
Initial Test			
Mean±SD	18.1±4.6	19.0±6.2	17.3±5.2
Median (Min-Max)	17.5 (13.4-22.8)	17.0 (11.3-26.1)	18.5 (8.9-22.7)
Final Test			
Mean±SD	14.5±2.3	18.3±5.8	17.8±4.9
Median (Min-Max)	14.2 (12.1-17.2)	16.7 (12.5-24.8)	19.3 (10.1-22.3)
Difference			
Mean±SD	3.6±2.3	0.7±1.4	-0.5±1.3
Median (Min-Max)	3.3 (1.3-6.2)	0.5 (-1.2-2.5)	-0.8 (-2.2-1.3)

Source: Research Data, 2022

Based on the table above, you can see an overview of the fat content of court tennis athletes. When conducting the initial test, the fat content (%) for the SR-Circuit Training group received a mean score of 18.1± 4.6 with a minimum value of 13.4 and a maximum of 22.8, while in the SO-Circuit Training group it received a mean score of 19.0± 6.2 with a minimum value of 11.3 and a maximum of 26.1, and in the control group, it received a mean value of 17.3±5.2 with a minimum value of 8.9 and a maximum of 22.7. When viewed from the mean value in the initial test on the fat content, the mean value of SO-Circuit Training is greater than SR-Circuit Training and SR-Circuit Training is greater than the dick group (SO >SR>Control). Then in the final test, the fat content in the SR-Circuit Training group got a mean score of 14.5±2.3 with a minimum value of 12.1 and a maximum of 17.2, while in the SO-Circuit Training group it got a mean score of 18.3±5.8 with a minimum value of 12.5 and a maximum of 24.8, and in the control group, it got a mean score of 17.8±4.9 with a minimum score of 10.1 and a maximum of 22.3. When viewed from the mean value in the final test, the fat content (%) mean value of SO-Circuit training is greater than the control group and the control group is greater than SR-Circuit Training (SO >Control>SR). When comparing the mean values in the initial test and the final test on fat content (%) there was a difference in the decrease in values in the SR-Circuit training and SO-Circuit training groups while in the control group there was an increase. In the SR-Circuit Training group, the mean value decreased by 3.6, while in the SO-Circuit Training group the mean value decreased by 0.7, and while in the control group the mean value increased by 0.5.

3.3 Discussion

Based on the results of the data processing above, it shows that there are differences in the improvement of physical components in the Circuit Training training variation group, in this case, SR-Circuit Training and SO-Circuit Training. The difference in the influence of variations in Circuit Training exercises is influenced by several factors, including;

1. The number of reps on each move.
2. Rest time between forms of exercise.
3. The average pulse of the exercise, and
4. Burning the number of calories during exercise.

Of the two variations of Circuit Training exercises carried out, the two groups both increased muscle endurance and cardiovascular endurance, as well as lower the fat levels of the samples of court tennis athletes. Following the many studies mentioned such by Harsono (2018), Anandiaz (2019), Sandy (2016), and many more.

However, from the results of research and data processing above, each variation has its advantages in improving the physical component for the better. The greatest increase in muscle endurance was obtained through SO-Circuit Training exercises, the greatest increase in cardiovascular endurance was obtained through SR-Circuit Training exercises, and a significant decrease in fat levels was obtained through SR-Circuit training exercises.

A large increase in muscle endurance through SO-Circuit Training is because the *SO-Circuit Training* group only focuses on doing strength training activities so that the sample of athletes who perform this variation can focus more on doing their job either with a larger number of reps or more perfect movements before being followed by a passive break of 30 seconds. It also refers to a study(Willardson & Burkett, 2006) which states that the dominant rest is 3-5min longer in total, allowing to perform more reps due to the availability of a large supply of ATP and PCr energy than in exercise groups that only have less rest.

From the results of the research in this study, it can be used by tennis physical trainers in determining the training program needed by each athlete, if athletes who already have good muscular endurance abilities but are lacking in cardiovascular endurance, coaches can use Circuit Training exercises with additional variations of running or also called SR-Circuit Training. If the athlete has a high-fat content, then you can use the SR-Circuit Training exercise.

In the future, more detailed research may be needed regarding the dietary patterns given to the sample of athletes, to have better accuracy of results in changes in the body composition of court tennis athletes.

IV. Conclusion

Based on the results and discussion above, it can be concluded that:

1. There is a significant difference between SR-Circuit Training and SO-Circuit Training exercises on muscle endurance.
2. There are significant differences between SR-Circuit Training and SO-Circuit Training exercises on cardiovascular endurance.
3. There is a significant difference between SR-Circuit Training and SO-Circuit Training exercises in reducing body fat levels.

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