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The Application of Periodization of Undulating Exercise to Improvement Muscular Endurance and Power Endurance

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Abstract

To improve aspects of the athlete's physical condition requires proper periodization. In addition to the training process with short match time available, training at the elite athlete level usually collides with the time available for practice and match time, therefore a training model or engineering is needed so that with the available time, a little training process can be useful and meaningful. The purpose of this study was to determine the impact of the application of periodization of undulating exercises on increasing muscle endurance and power endurance. The research method is experimental, the design used is one group pretest-posttest, and the sample is 12 people. The instrument used for muscular endurance is the wall sit, and for power endurance is the hard jump. For data analysis using pared sample t test. The results showed that there was an increase in muscle endurance and power endurance after being given a strength training program with undulating periodization. This is evidenced by the results of data processing which show a significant value of muscle endurance and strength endurance of 0.00 < 0.05. The conclusion is that the implementation of an undulating periodic training program has a significant impact on increasing muscle endurance and power endurance.

Keywords:

Muscle Endurance, Periodization of Undulating Exercise, Power Endurance

Introduction

The phenomena that occur in the field are related to achievement, namely the weakness that is still experienced by coaches is how the coach determines the proper dose of training aspects and according to the needs of athletes and the demands of sports with uncertain situations and conditions of sports calendarization. Furthermore, the coaches' lack of understanding of how to improve and develop physical abilities at the elite athlete level in a more comprehensive and specific manner still occurs. Weaknesses that occur in the achievements of elite athletes are caused by the fact that there are still many trainers who have not been able to optimize the potential of their athletes due to limited knowledge about sports training, especially physical training, (Sidik et al, 2019).

At present sports require athletes to be in excellent physical condition, this is a process where athletes are required to always practice and ensure that technical movements are carried out as well as possible (Mendes, 2016). The physical condition is a unified whole that cannot be separated, either from improvement or maintenance. This means that in an effort to improve the physical

condition, every component of the physical condition also needs to be developed. It is a main requirement for an athlete to develop his achievements, even physical condition is said to be a basic necessity that cannot be postponed or negotiable, the better the physical condition of an athlete, the higher the factors supporting achievement, (Meja et al., 2015).

In an effort to improve athlete performance in sports there is no other way than by training, practicing seriously and earnestly guided by a well-planned and well-organized training program. The physical condition training program must be properly designed and systematically adapted to the needs of each sport branch which is aimed at increasing the functional abilities of the body in supporting sports achievements (Sidik et al., 2019).

One aspect to improve performance is the existence of a training program planning. To achieve high performance results in performance sports, proper training periodization is necessary (Antretter et al., 2018). Training programs that are designed and structured through periodization have the maximum increasing effect compared to training programs that are not arranged periodically through training periods (Williams et al., 2017). Periodization has been defined as planning methods and structuring the training process which involves a logical and systematic series of training variables (intensity, volume, frequency, recovery period and training) in an integrative fashion aiming to optimize specific performance results at predetermined points in time (Naclerio et al. 2013).

The term Periodization refers to two important aspects, namely the Periodization of the Annual Plan, which allows to divide and manage training programs and achieve maximum form for the biggest matches, and the Periodization of Motor Capacity or organic muscles, which allows to bring at an optimal level of skills, such as strength. , speed and endurance (Raiola & D'isanto. 2016). Two of the most frequently mentioned periodization models in the literature are linear periodization and undulating periodization. Linear periodization is defined as involving the breakdown of annual training into weekly (microcycle), monthly (block or mesocycle) and multimonthly (macrocycle). The main characteristics of linear periodization are high initial volume and low intensity, increasing intensity and decreasing volume over a training period gradually (Simão et al., 2012). Wavy periodizations are described more frequently as varying intensity and volume daily, weekly, or biweekly and generally use the maximum repetition zone to plan training intensity (Mann et al., 2010).

Periodization of waves (undulating) is described as variations in intensity and volume that vary more on a daily or weekly basis and use maximum reps to determine exercise intensity (Buford et al, 2007). Undulating periodization is generally identified as daily wavy periodization or weekly wavy periodization depending on the volume and intensity of exercise manipulated daily or weekly (Harries et al., 2015). Undulating Periodization can be considered appropriate for a soccer team that has a short pre-season. (Charles Ricardo LOPES et al., 2015). The notion of undulating periodization of volume and intensity is changed more frequently (daily, weekly, or biweekly) to give the neuromuscular system more frequent recovery periods (Buford et al., 2007). Studies have statistically shown that there is a statistically significant increase in maximal strength for daily wavy periodization compared to strength-power periodization in subjects with low to moderate levels of

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performance (Hartmann et al., 2015). Several studies have shown that the periodized or undulating wave shape model has suggested that varying the intensity and volume can provide a greater change in excitability and recovery period and is more conducive to increasing strength (Rhea et al., 2002).

One of the physical components needed to achieve maximum performance is strength. If the physical condition is good, there will be an increase in strength, flexibility, stamina, speed, endurance, etc. (Supriyoko & Mahardika, 2018). Endurance is one of the most important elements that athletes must have and can affect the performance of athletes in a soccer team, good endurance is a factor that supports the appearance of every soccer player so that they always concentrate on playing and last a long time. (Chan et al., 2016). An athlete with good endurance will avoid the risk of injury because his physical abilities are ready to carry out long-intensity activities (Hondt & Verhagen, 2021). Endurance functions to maintain physical condition when the game is running, and endurance also plays an important role in maintaining emotional stability when playing. (Study et al., 2016). Endurance training can also be proven to increase the strength of players who can run at high intensity (Helgerud et al., 2011).

Adequate body muscle endurance is an important role for the body to avoid the risk of injury and can maintain the performance of athletes to appear good and consistent (Evans et al., 2007). Muscular endurance can be the ability of a group of muscles to carry out movement activities for a long time without getting injured and if the injury can recover quickly (Winarni, 2015). The factor that is known to be very important for maintaining muscle endurance is the blood supply factor to active muscle mass so that it makes the muscles last long and avoid injury, blood supply is also very important in providing oxygen and nutrients to muscle tissue (Heyward, 2013).

In the context of endurance, each player must cover a distance of 8-12 km in a match and the average intensity is between 80-90% of maximum heart rate. Therefore, strength and endurance are the main fitness elements so that players can perform well in a soccer match (Chan et al., 2016).

Power Endurance is a combination of Endurance and Explosive Power (Power). According to Subarjah (2013) endurance is a person's ability to do work in a relatively long time, what is meant by muscle endurance is the ability of the muscles to contract or work in a relatively long time. Meanwhile, according to Bompa (2009), explosive power is the product of two basic capabilities, namely strength and speed to perform maximum force in a very short time. So it can be concluded that Power Endurance is the athlete's ability to overcome fatigue when carrying out fast and strong movements repeatedly with the same quality every time they are carried out.

The development of achievement sports always demands the appearance of athletes in excellent physical condition. when an athlete trains in large volumes or at very high intensities, fitness will increase but fatigue will also increase (Bompa, 2009). Therefore, to overcome excessive levels of fatigue, a good training program is needed to increase Power Endurance abilities (Chan et al., 2016).

However, the training process related to strength is often ignored by coaches, especially when the game time is very tight. Training at the level of elite athletes usually collides with the time available for practice and match time, therefore a training model or engineering is needed so that with a little available time the training process can be useful and meaningful. An exercise program

with undulating periodization can be an effective solution to increase muscle endurance and power endurance in a limited time. Undulating periodization involves varying the intensity and volume of exercise within each training session or over a period of time, which helps stimulate different adaptations in the body.

Methods

The method used is experimentation, this method directly tries to influence certain variables, if applied correctly is the best method for testing assumptions. While the approach uses the one-group pretest-posttest, in this design it is necessary to measure or observe a group not only after treatment but also beforehand (Fraenkel, Wallen, & Hyun, 2012).

Participant

The participants involved in this study were football athletes at the Indonesian University of Education. The reason for choosing soccer athletes was because there were frequent championships, and the exercises that were often carried out were tactics while strength training was often ignored.

Population & Sample

The population in this study were 24 Indonesian University of Education football athletes. Meanwhile, the selection of the sample used a purposive technique, with the criteria being male athletes in excellent physical condition, having trained for at least 1 year, not suffering from acute illness or injury, often participating in championships. With this sampling technique, a total of 12 people were produced.

Instrument

To measure muscle endurance, namely the Wall Sit Test (Palguna et al., 2018), the implementation is that the athlete warms up, after the athlete's signal attaches his back to the wall, then the body is in a sitting condition like in a chair but without using a chair, the knees are bent to form 90˚ angle, hands beside the body, look ahead, do it as long as possible, the assistant records how long it takes to do the wall sit. Whereas to measure power endurance, namely the multistage hurdle jump test (Dikdik Zafar Sidik & Fitri Rosdiana (2022), the test begins with the preparation of the test standing next to the hurdle which has been prepared with the body position standing upright and feet shoulder-width apart, then on the aba -aba "yes" the testee jumps to the left and right over the top of the hurdle with both feet for 60 seconds until there is a signal "stop". The number of jumps will be counted and recorded during the 60 seconds the testee does.

Procedure

The procedure or steps taken are as follows:

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1) Conduct field studies, namely determining the population and sample that will be used as research objects.
2) Conduct a pre-test of endurance and power endurance on the sample.
3) Provide training/treatment programs to the sample.
4) Conduct post-tests of endurance and Power endurance on samples.
5) After that do the processing and analysis of data.
6) The final step is to determine conclusions based on the results of data analysis.

The following is an exercise program given to the sample for 8 weeks

Table 1. Undulating Exercise Program

Exercise		leg press	leg extention	leg curl
Intensity	30%	14 rept	14 rept	14 rept
	80%	4 rept	4 rept	4 rept
	60%	8 rept	8 rept	8 rept
Volume	week 1	3 set	3 set	3 set
	week 2	4 set	4 set	4 set
	week 3	5 set	5 set	5 set
	week 4	4 set	4 set	4 set
	week 5	5 set	5 set	5 set
	week 6	6 set	6 set	6 set
	week 7	5 set	5 set	5 set
	week 8	6 set	6 set	6 set

Data Analysis

Quantitative data obtained from the test results were then analyzed using the SPSS software, namely using a paired sample t-test.

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Result

After testing the samples and obtaining the results, the next step is to process the data so that the scores obtained have meaning.

Table 2. Data on Muscular Endurance and Power Endurance

No	Name	Muscle Endurance		Power Endurance	
		Pre Test	Post Test	Pre Test	Post Test
1	X	60,00	123,00	64,00	98,00
2	X	58,00	160,00	46,00	88,00
3	X	56,00	121,00	38,00	47,00
4	X	69,00	142,00	62,00	84,00
5	X	127,00	192,00	42,00	58,00
6	X	108,00	164,00	48,00	58,00
7	X	76,00	176,00	39,00	52,00
8	X	93,00	182,00	56,00	78,00
9	X	78,00	148,00	45,00	92,00
10	X	74,00	146,00	52,00	75,00
11	X	94,00	175,00	65,00	92,00
12	X	86,00	172,00	62,00	90,00

The initial step taken before testing the hypothesis is to carry out a normality test, the results are as follows:

Table 3. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre_Test_Muscle_Endurance	.150	12	.200*	.937	12	.460
Post_Test_Muscle_Endurance	.142	12	.200*	.950	12	.637
Pre_Test_Power_Endurance	.185	12	.200*	.910	12	.212
Post_Test_Power_Endurance	.178	12	.200*	.893	12	.129

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on these results, the analysis of normality data uses Shapiro Wilk, this is because the number of samples is included in the small group. The normality results of the pre-test and post-test data for muscle endurance and power endurance show that the data is normally distributed, because the

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significance value is > 0.05. Thus, statistical testing uses parametric. Furthermore, the data obtained is calculated using the pared sample t test. The result is as follows:

Table 4. 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	Pre_Test_Muscle_Endurance - Post_Test_Muscle_Endurance	-76.833	14.800	4.272	-86.237	-67.429	-17.98	11	.000
Pair 2	Pre_Test_Power_Endurance - Post_Test_Power_Endurance	-24.416	12.026	3.471	-32.057	-16.775	-7.033	11	.000

Based on the results of the pared sample t test, the significance value for muscle endurance and power endurance is 0.00 <0.05, it can be stated that the application of undulating exercises provides a significant increase in muscle endurance and power endurance.

Discussion

The results of the data analysis show that the application of undulating exercises provides an increase in the ability of muscle endurance and power endurance. This is proven based on the facts and data obtained and the results can be seen in the following figure.

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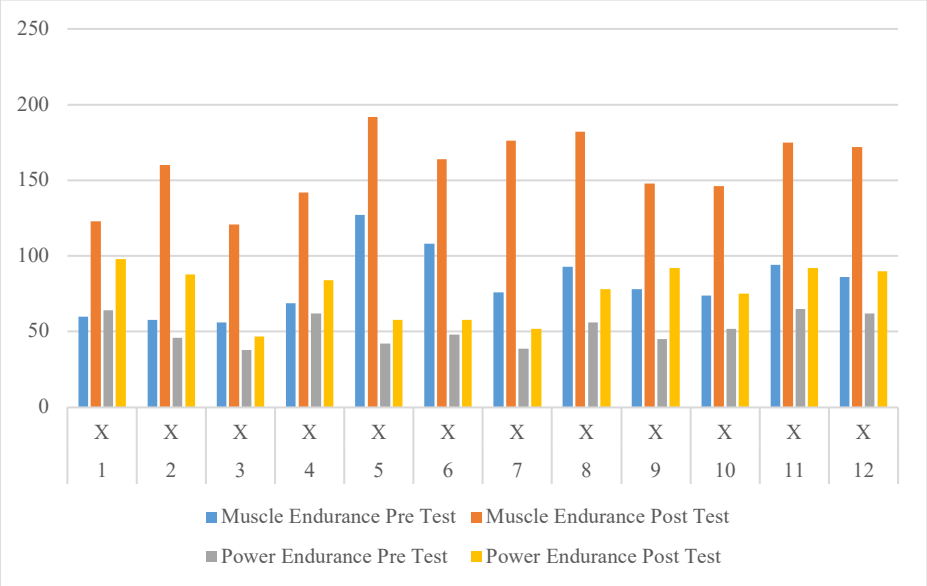

Figure 1. Graphic of Muscle Endurance and Power Endurance Results

From the figure it can be seen that there was an increase from the pre test muscle endurance and power endurance to the post test after being given the undulating exercise treatment. Furthermore, after the parried sample t test was carried out, it showed a significance value that was smaller than the calculated t value. This indicates that the application of undulating exercises has an impact on increasing muscle endurance and power endurance of Indonesian University of Education football athletes.

Thus the application of undulating exercises can be a recommendation for coaches in the face of a match that is only a short time away. This is in accordance with what was stated by Franchini et al, (2015) that the daily undulating periodization (DUP) model training program is better for increasing strength compared to the nonperiodized single set program in female tennis players in college. Furthermore, Douglas L. Peixoto, et al, (2022) suggested that the daily undulating periodization model provides a more tangible increase in strength and is an attractive strategy for improving body composition, strength, and muscle endurance.

Of course the results of this study are far from perfect, this is because the sample taken is only college athletes. For this reason, it is hoped that future researchers will conduct more extensive research, for example elite athletes and be carried out on various aspects of the physical condition of other strengths.

Conclusion

Based on the results of data processing and analysis that has been done, it can be concluded that the application of undulating exercises has a significant effect on increasing muscle endurance and power endurance.

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