

# Reverse Periodization Model to Increase Anaerobic and Aerobic Capacity

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**Abstract** Circuit training is a training method used to efficiently maximize training time while providing more comprehensive, greater, and faster benefits in shaping, developing, and improving the work function of an athlete's body. This study aimed to increase anaerobic and aerobic capacity which includes speed, agility, power, power endurance, and endurance through the circuit training method applied to the Reverse periodization model. The method used in this research is an experiment with a One-Group Pretest-Posttest design. The sample in this study was a university's Women's Futsal Student Activity Unit with a total of 14 Students. The research instrument was in the form of anaerobic and aerobic ability tests. The results showed a significant effect of the circuit training method on the reverse periodization model on anaerobic and aerobic capacity. To get optimal results, athletes must manipulate a small volume of exercise at the beginning and keep increasing until the end of the meeting. Moreover, the high intensity at the beginning of the meeting was followed by a decrease until the end of the meeting. Indeed, this also should be supported by utilizing the forms of agility and power movements at each post in a structured, measured, orderly manner and interspersed activity.

**Keywords** Circuit Training, Reverse Periodization, Aerobic, Anaerobic

## 1. Introduction

Futsal is a physically dominant sport in this case

following some literature which shows that the physical demands on the futsal sport are an important factor that must be considered by the coach in terms of training carried out for later participation in competitions [1,2,3,4]. The demands of physical ability include anaerobic and aerobic capacity consisting of speed, agility, power, power endurance, and endurance. Futsal activities are carried out with high intensity by doing a lot of repeated acceleration, running, and changing directions, and each player must attack and defend his skills consistently. Thus, a player is required to have excellent skill endurance because the characteristics of futsal itself require high aerobic ability supported by good anaerobic ability [5].

Aerobic physical ability as a fundamental and very important factor in improving athlete performance is seen from the analysis of movement demands in futsal that the players run more than 4,500 meters during the match [6,7]. And players 8.9% run (speed 25 km/h-L) with a high intensity of their total distance. In addition, players make a low-intensity effort every 14 seconds, a medium-intensity effort every 37 seconds, a high-intensity effort every 43 seconds, a maximum intensity effort every 56 seconds, and change the movement activity every 3.3 seconds [8]. From these findings, it can be concluded that futsal is an anaerobic multiple-sprint sport where high-intensity training makes up a larger proportion of a match.

Aerobic respiration releases much more energy than anaerobic respiration. Anaerobic respiration releases less energy than aerobic respiration, but it does this more quickly. This reaction is lactic acid. This builds up in muscles causing pain and tiredness, which can lead to cramps. If the intensity of anaerobic exercise continues to

be increased, it will cause fatigue resulting from high lactate; this is at risk of causing easy injury. However, intense anaerobic workouts can also increase fast twitch muscle size and quantity, improving muscle power, strength, and size. Anaerobic exercise helps build tolerance to the lactic acid that causes fatigue, improving muscle endurance. According to the theory that aerobic capacity will be better if there is progress in anaerobic capacity, and anaerobic capacity will be better if aerobic capacity has progressed better because of a faster recovery period. Thus, anaerobic and aerobic abilities are interrelated.

Aerobic endurance performance depends on maximal oxygen uptake ( $\text{VO}_2 \text{ max}$ ).  $\text{VO}_2 \text{ max}$  is defined as the highest oxygen uptake a person achieves during exercise [9-11]. One way to improve anaerobic and aerobic abilities is the Circuit Training method. Circuit training is an exercise program consisting of several posts and at each post, an athlete performs a predetermined type of exercise. Exercises usually consist of 9-12 posts arranged in the form of a circuit [12]. This circuit training method is applied periodically which is planned in a structured, measurable, and regular program based on the stages of training, because the physical condition can reach an optimal point if the exercise is done repeatedly, and continuously periodically under the principles and norms of correct and good practice. Training that has long-term, medium-term, and short-term planning is usually called periodization. According to literature [13], it defines periodization is a systematic planning process of short and long-term training programs by varying the training and recovery load. According to Williams *et al.* [14] periodization is a method for organizing training into sequential phases to increase the potential for achieving goals. Later Dewese *et al.* [15] periodization was considered an integral part of the training process and provided a conceptual framework for designing training programs.

In a base of Periodization, there are several forms of periodization models including linear (traditional) and nonlinear (non-traditional) periodization, but all periodization models have the same principle consisting of three phases, including the preparation phase, the competition phase, and the transition or recovery phase [16,17]. Non-traditional/non-linear periodization models include Reverse periodization and block periodization models [18]. Non-linear periodization is based on the concept that volume and load changes are more frequent (daily and weekly) to allow for a longer recovery period because lighter loads are carried out more often [19]. The linear periodization model works starting from low-intensity and high volume with gradual changes in volume and intensity [18,20]. In the reverse periodization model, the training program starts with high intensity and the volume is low, and gradually the intensity decreases and the volume increases, or an intensity is maintained and volume increased depending on the sport [21-23]. The reverse periodization is based on a low training volume

combined with high-intensity, initiating high-intensity application from the start of the macrocycle [24].

Several studies showed that reverse periodization is a specific and efficient training strategy for training sprinters because it shows a significant value above the traditional periodization average value [25]. Then, this study showed that a gradual increase in volume and decrease in intensity was the most effective program for increasing muscle endurance [26]. Then, Circuit Training resulted in a significant increase in  $\text{VO}_2 \text{ max}$  [27]. Several studies stated that concerning the reverse periodization model, linear periodization presented more positive effects on body composition [28] and increased  $\text{VO}_2 \text{ max}$  in the block periodization group [29].

Based on the above explanations, there are still many factors that must be studied further regarding the application of the Circuit Training method in the reverse periodization model to increase anaerobic and aerobic capacity to ensure all these conclusions. Therefore, this research can be developed and applied as an alternative or solution to various problems in the field.

## 2. Materials and Methods

The method used One-Group Pretest-Posttest Design. The tests were carried out before and after the treatment to understand the impact of the treatment [30]. The research was carried out for four weeks with 12 meetings (the training was carried out three times a week. This research was conducted at Universitas Pendidikan Indonesia Jl. PHH Mustofa, No. 200, Padasuka, Bandung from 29 March 2022 to 23 April 2022.

The population in the study was all members of the University's Women's Futsal Student Activity Unit with a total of 14 people. The considerations or characteristics of the sample in this study are 1) Women's Futsal athletes who are active in training, 2) Those willing to follow the research to the end, 3) Athletes who have been trained, and 4) Those having good achievements. The sampling technique in this research is the purposive sampling technique. Based on the literature [31], the use of this sampling technique has a purpose or is done intentionally. Thus, the sample can represent previously known population characteristics.

In the implementation of the initial stage, we conducted initial testing and measurements to determine the initial condition of the subject. The test was carried out after the sample was warmed up. Then, the test was carried out before carrying out other strenuous exercise activities. The sample was given circuit training method treatment through a reverse periodization model (reverse) for 12 months. After the treatment finished, the final stage of testing and measurement was carried out with a final test to understand the progress of the results of the training treatment. The steps taken in data collection followed the test procedure. The type of data collected is quantitative analysis. Aerobic capacity data collection was carried out

using a test instrument, namely the bleep test [32]. The anaerobic capacity collection instrument uses several instruments consisting of a speed test in the form of Speed (i.e. 20-m dash sprint test), speed in Agility form (i.e. shuttle run 4 m x 5 rep) [33], Leg power (i.e. Vertical Jump which has taken into account the unit of watts) [34], and the Power Endurance (i.e. Multi-Stage Hurdle Jump Test) [35]. The data were analyzed using SPSS software. The analytical technique used is Paired Sample T-Test.

### 3. Results

This test is conducted to test whether there is a difference or influence. When evaluating the effect of increasing the circuit training method on the reverse periodization model on the increase in anaerobic and aerobic capacity, the first step was to perform a normality test using Shapiro Wilk. Then because the distribution of the subjects was normal, it was continued by testing the paired sample T data (see Table 1).

**Table 1.** Research Result Data

Component	circuit training method on the reverse periodization model			
	Mean		Correlation	Sig.
	before	After		
Anaerobic	2.50	2.74	0.788	0.001
Aerobic	33.42	37.47	0.854	0.000

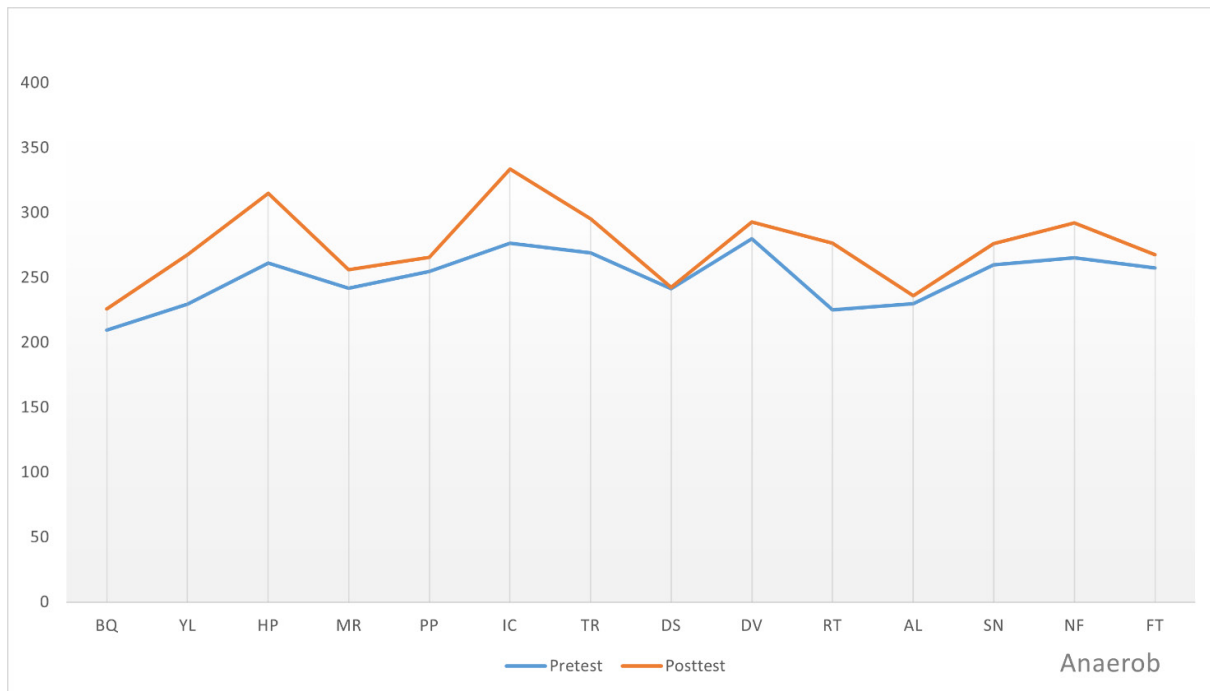
The mean score for the anaerobic pretest was 2.50,

which is less than the posttest (2.74). The mean score for aerobics was 33.42 and 37.47 for pre-test and post-test. Thus there is a difference in the average results of the exercise between the pretest and post-test. The value of the anaerobic correlation coefficient is 0.788 with a significance value of 0.001, and the aerobic correlation coefficient is 0.854 with a significance value of 0.000. Because of Sig. value < 0.05 probability, there is a relationship between the pretest and post-test variables. To prove whether the difference is significant or not, it is necessary to interpret the results of the paired sample T-test as shown in Table 2.

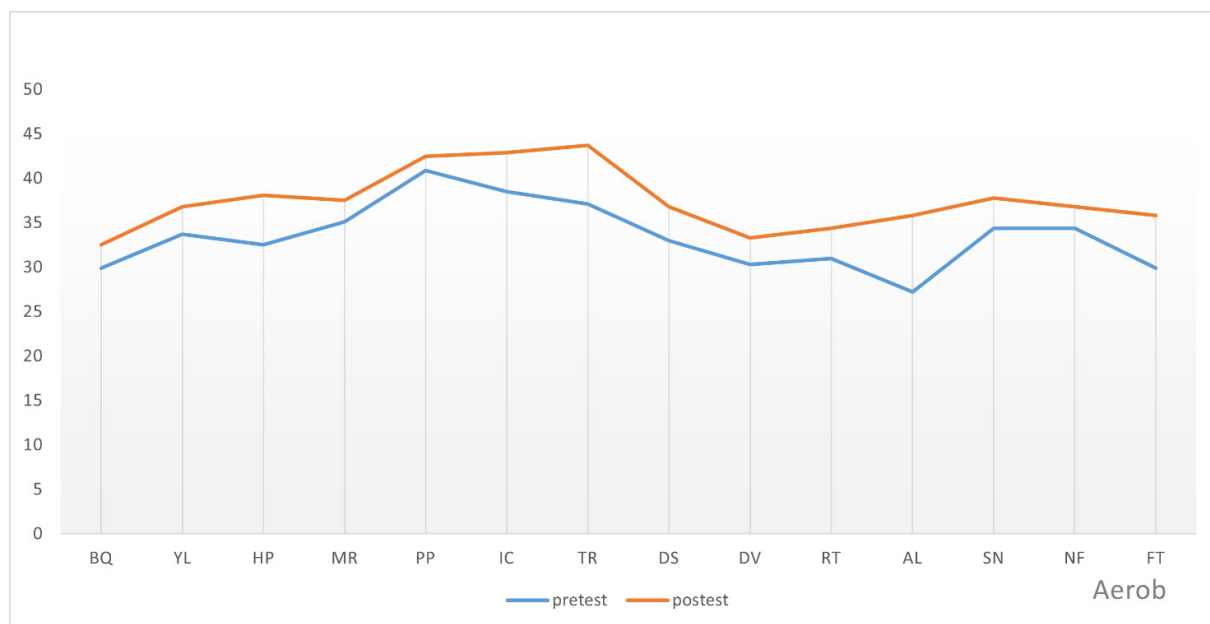
**Table 2.** The results of paired sample t-test

Components of	circuit training method on the reverse periodization model		
	Results	Sig.	Note
Anaerobic	Improved	0.000	Significant
Aerobic	Improved	0.000	Significant

Based on the test table above, the value of Sig. Anaerobic (2-tailed) value of 0.000 (< 0.05), it can be concluded that there is an average difference between the pretest and post-test, which means that there is an effect of the Circuit Training method on the reverse periodization model on increasing anaerobic ability. Then, Sig. the (2-tailed) aerobic value was 0.000 (< 0.05), which indicates that there is a difference in means of the pretest and post-test. This means that there is an effect of the Circuit Training method on the reverse periodization model on increasing aerobic ability. For more details, the improvements are presented in Figures 1 and 2.



**Figure 1.** The percentage of the initial test and final test of anaerobic ability improvement influenced by the circuit training method on the reverse periodization model



**Figure 2.** The percentage of the initial test and final test of aerobic ability improvement influenced by the circuit training method on the reverse periodization model

## 4. Discussion

Based on the data results regarding the average aerobic and anaerobic ability with the circuit training method applied to the reverse periodization model, there is a difference in the average scores. This is the first study to analyze the effect of the circuit training method by applying it to the reverse periodization model on increasing the aerobic and anaerobic capacity of female futsal players. The circuit method training on the reverse periodization model has a significant impact on physiological changes in anaerobic and aerobic capacity. According to Martin et al., [24] reverse periodization initiates high-intensity application from the beginning of the macrocycle and later gradually increases volume and decreases intensity [36]. Several results regarding reverse periodization reported that reverse periodization training was found to be an effective and efficient strategy to improve primary performance [37]. Then, reverse periodization is a specific and efficient training strategy for sprinters when it reduces the volume of training load significantly [26]. Judging from the explanation above, the character of this reverse periodization encourages players to move faster at each post in the circuit practice.

This circuit training is one of the most popular methods, consisting of several posts. There are usually 9-12 posts. In each post, an athlete performs a predetermined type of exercise [12]. Circuit training is one of the beneficial forms of cardiorespiratory exercise because these forms of circuit training are a combination of all physical elements. According to literature [38], circuit training is an anaerobic endurance training method and aerobics. Its purpose was to improve cardiopulmonary and musculoskeletal health.

Then, high-intensity circuit training can increase muscle endurance in a reasonably fit population [39] and can significantly increase  $VO_2$  max [27].

The circuit training carried out between posts does an active recovery (by jogging) between posts allowing players to recover because they have a fairly good basic endurance. Towards the final week of the meeting when the intensity is lowered and the volume of training is increased, players feel better physiological adaptations, especially in recovery, so that anaerobic capacity can be better. This point is underpinned by the theory which says that aerobic capacity will be better if there is progress in anaerobic capacity, and anaerobic capacity will be better if aerobic capacity has progressed better because of a faster recovery period [40]. This will provide an opportunity for anaerobic training to get more density.

From several research results regarding circuit training, reverse periodization which influences anaerobic and aerobic capacity is in line with this study. In this study, the circuit training method applied in the reverse periodization model can also affect physiology.

Further research with a longer trial period and larger sample size are needed in several populations of sports. Indeed, this is a relatively unexplored area of research and there is a great opportunity for further research intending to maximize the development and improvement of athletes' performance in sports over the long term.

## 5. Conclusions

The character of the reverse periodization is rooted at the beginning of the macrocycle, the exercise is started at high intensity and low volume and gradually volume is

increased, and intensity is decreased. The conclusion of this study is that the application of the circuit training method in the reverse periodization model has a significant effect on increasing anaerobic and aerobic capacity based on the manipulation of small exercise volumes at the beginning of the meeting. The increasing trend will not end until the end of the meeting, while the high intensity at the beginning of the meeting will be followed by a decrease until the end of the meeting. The way it works is utilizing the forms of agility and power movements at each post in a structured, measurable and regular manner and interspersed with active rest (jogging) at intervals from post to post.

For further research, research on circuit training methods in this periodization model can be adapted to the training needs of each sport. Furthermore, further research needs to be done with a longer trial period and larger sample size.

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## REFERENCES

- [1] C. Castagna, S. D. Ottavio, J. Granda, and B. Alvarez. Match demands of professional Futsal : A case study. vol. 12, pp. 490–494, 2009.
- [2] E. C. P. L. J. B. M. BARONI. Aerobic capacity of male professional futsal players. *J. Sports Med. Phys. Fitness*, vol. 50, no. September, pp. 395–399, 2014.
- [3] R. Ramirez-campillo et al. Effects of plyometric training on maximal-intensity exercise and endurance in male and female soccer players. no. July, 2015.
- [4] M. Karahan. The Effect of Skill-Based Maximal Intensity Interval Training on Aerobic and Anaerobic Performance of Female Futsal Players. pp. 223–227, 2012.
- [5] C. C. A. E. Castellini. Vertical Jump Performance in Italian Male and Female National Team Soccer Players. *J. Strength Cond. Res.* vol. 4, no. 27, pp. 1156–1161, 2013.
- [6] Pate RR, Kriska A. Physiological basis of the sex difference in cardiorespiratory endurance. *Sports Medicine*. vol. 1, no. 2, pp. 87-98, 1984.
- [7] N. Makaje, R. Ruangthai, A. Arkarapanthu, and P. Yoopat. Physiological demands and activity profiles during futsal match play according to competitive level. *J Sport. MED PHYS Fit.* vol. 52, no. February 2014, pp. 366–74, 2012.
- [8] A. J. M. Sera N. Dogramaci, Mark L. Watsford. Time-Motion Analysis of International and National Level Futsal. *J. of Strength Cond. Res.* vol. 3, no. 25, pp. 646–651, 2011.
- [9] Hoff J, Wisløff U, Engen LC, Kemi OJ, Helgerud J. Soccer specific aerobic endurance training. *British journal of sports medicine*. vol. 36, no. 3, pp. 218-221, 2002.
- [10] Helgerud J, Engen LC, Wisløff U, Hoff J. Aerobic endurance training improves soccer performance. *Medicine and science in sports and exercise*. vol. 33, no. 11, pp. 1925-1931, 2001.
- [11] Montero, D., Diaz-Cañestro, C., & Lundby, C. Endurance Training and VO<sub>2</sub> max: Role of Maximal Cardiac Output and Oxygen Extraction. *Medicine and Science in Sports and Exercise*, 47(10), 2024–2033, 2015. doi.org/10.1249/MSS.0000000000000640.
- [12] Adamson, G.T. Circuit Training. *Ergonomics*, 2(2), 183-186. 2010. https://doi.org/10.1080/00140135908930423.
- [13] Lambert MI, Viljoen W, Bosch A, Pearce AJ, Sayers M. General principles of training. In: Schwellnus MP, ed. *Olympic Textbook of Medicine in Sport*. Chichester, UK: Blackwell Publishing; 1–48, 2008.
- [14] Williams, T. D. et al. Comparison of Periodized and Non-Periodized Resistance Training on Maximal Strength : A Meta-Analysis Data were extracted and independently coded by two', *Sports Medicine*. Springer International Publishing, 2017. doi: 10.1007/s40279-017-0734-y.
- [15] Deweese, B. H. et al. The training process : Planning for strength – power training in track and field. Part 1 : Theoretical aspects'. Elsevier B.V., 4(4), pp. 308–317, 2015. doi: 10.1016/j.jshs.2015.07.003.
- [16] Mattocks, K. T., Dankel, S. J., Buckner, S. L., Jessee, M. B., Counts, B. R., Mouser, J. G., Laurentino, G. C., & Loenneke, J. P. Periodization: What is it good for? *Journal of Trainology*. 5, 6–12, 2016.
- [17] Bompa, T.O. *Periodization: Theory and Methodology of Training (Fourth Edition)*. United States: Human Kinetics, 1999.
- [18] Clemente-Suárez, V. J., & Ramos-Campo, D. J. Effectiveness of reverse vs. Traditional linear training periodization in triathlon. *International Journal of Environmental Research and Public Health*. 16(15), 1–13, 2019. https://doi.org/10.3390/ijerph16152807.
- [19] Lorenz, D., & Morrison, S. Periodisation strength physical therapy. *The International Journal of Sports Physical Therapy*, 10(6), 734–747, 2015.
- [20] Fleck, S. J. Non-Linear Periodization for General Fitness & Athletes. *Journal of Human Kinetics, Special Issue*, 41–45, 2011. https://doi.org/10.2478/v10078-011-0057-2.
- [21] Restes et al. Linear Vs Reverse Linear Periodisation. *Journal of Strength and Conditioning*. 23(1), 266–274, 2009.
- [22] Gonzalez-rave, J. M. and Sortwell, A. Comparison between traditional and reverse periodization : swimming performance and specific strength values. 2, 87–96, 2013.
- [23] Javier, V. Effectiveness of Reverse vs Traditional Linear Training Periodization in Triathlon. pp. 1-13, 2019.
- [24] Martín, J. P. G., Clemente-Suárez, V. J., & Ramos-Campo, D. J. Hematological and running performance modification of trained athletes after reverse vs. Block training

- periodization. *International Journal of Environmental Research and Public Health*. 17(13), 1–11, 2020. <https://doi.org/10.3390/ijerph17134825>.
- [25] Arroyo-Toledo, J., Clemente-Suárez, V., & González-Ravé, J. M. Effects of traditional and reverse periodization on strength, body-composition and swim performance. *Imperial Journal of Interdisciplinary Research*. 2(12), 474–481, 2016.
- [26] Arroyo-toledo, J. J., Clemente, V. J., J, J. M. G. D., Campo, R., & Sortwell, A. D. Comparison between traditional and reverse periodization: swimming performance and specific strength values. *International Journal of Swimming Kinetics*. 2(1), 87–96, 2013.
- [27] Wirat Sonchan, Pratoon Moungmee, A. S. The Effects of a Latihan Sirkuit Program on Muscle Strenght, Agility, Anaerobic Performance and Cardiovascular Endurance. *International Journal of Sport and Health Science*. 11(4), 176–179, 2017.
- [28] Prestes, J., De Lima, C., Frollini, A. B., Donatto, F. F., & Conte, M. Comparison of linear and reverse linear periodization effects on maximal strength and body composition. *Journal of Strength and Conditioning Research*. 23(1), 266–274. 2009. <https://doi.org/10.1519/JSC.0b013e3181874bf3>.
- [29] Rønnestad, B. R., Hansen, J., & Ellefsen, S. Block periodization of high-intensity aerobic intervals provides superior training effects in trained cyclists. *Scandinavian Journal of Medicine and Science in Sports*, 24(1), 34–42, 2012. <https://doi.org/10.1111/j.1600-0838.2012.01485.x>.
- [30] Fraenkel, J. R., & Wallen, N. E. *How to Design and Evaluate*. (p. 642), 2012.
- [31] Sugiyono. *Metode Penelitian Pendidikan*. Bandung. *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, Dan R&D)*. 308, 2015.
- [32] Paradisis, G. P., Zacharogiannis, E., Mandila, D., Smirtiotou, A., Argeitaki, P., & Cooke, C. B. Multi-stage 20-m shuttle run fitness test, maximal oxygen uptake and velocity at maximal oxygen uptake. *Journal of Human Kinetics*. 41(1), 81–87, 2014. <https://doi.org/10.2478/hukin-2014-0035>.
- [33] B. Mackeinze, *101 Performance Evaluation Tests*. London: Electric Word Plc. 2005.
- [34] Sayers, S. P., Harackiewicz, D. V., Harman, E. A., Frykman, P. N., & Rosenstein, M. T. Cross-validation of three jump power equations. *Medicine and Science in Sports and Exercise*. 31(4), 572–577. 1999. <https://doi.org/10.1097/00005768-199904000-0001>.
- [35] K. L. Homs and D. H. Annis. *Athletic performance rating system*. Pat. Appl. Publ., vol. 1, no. 19, 2009.
- [36] Rhea, M. R., Ball, S. D. and Phillips, W. T. A Comparison of Linear and Daily Undulating Periodized Programs with Equated Volume and intensity for local muscular endurance. 4287. 2003. (August 2016). doi: 10.1519/1533-4287(2003)017<0082.
- [37] Clemente-suárez, V. J., Dalamitros, A., & Ribeiro, J. The effects of two different swimming training periodization on physiological The effects of two different swimming training periodization on physiological parameters at various exercise intensities. *European Journal of Sport Science*. 17(4), 425-432. 2017. <https://doi.org/10.1080/17461391.2016.1253775>.
- [38] Jun, H. ju, Jeong, C. J., Yang, H. S., Jeong, Y. rim, Jegal, H., & Yoo, Y. D. The Effects of sirkuit Training and sirkuit Training with Whole Body Vibration on Pulmonary Function in Adolescent. *Journal of International Academy of Physical Therapy Research*. 6(2), 902–907, 2015. <https://doi.org/10.5854/jiaptr.2015.10.30.902>.
- [39] Schmidt D, Anderson K, Graff M, Strutz V. The effect of high-intensity circuit training on physical fitness. *The Journal of Sports Medicine and Physical Fitness*. May;56(5):534-540, 2016. PMID: 25942012.
- [40] Giriwijoyo, S. dan Sidik, D.Z. *Ilmu Faal Olahraga (Fisiologi Olahraga): Fungsi Tubuh Manusia pada Olahraga untuk Kesehatan dan Prestasi*. Bandung: Remaja Rosdakarya, 2012.