



## The Effects of Interval Training on The $VO_{2max}$ on The Basket Ball Players

**Fekie Adila\***

Universitas Riau,  
INDONESIA

**Ittaqwa**

Universitas Negeri Malang,  
INDONESIA

**Muhammad Khozin**

Universitas Negeri Surabaya,  
INDONESIA

**Khoirul Fatihin**

Universitas Negeri Surabaya,  
INDONESIA

**Triatmo Joko Purnomo**

Universitas Negeri Malang,  
INDONESIA

### Article Info

#### Article history:

Received: May 25, 2023

Revised: June 20, 2023

Accepted: July 21, 2023

#### Keywords:

Interval training;  
 $VO_{2max}$  endurance;  
Basketball.

### Abstract

Endurance plays an active role in basketball games as a support for implementing strategy and tactics, so players must have excellent endurance. The study aims to determine the impact of interval training on high school basketball players' endurance. The research applied the experimental method. The samples are ten participants of the As-Shofa basketball team determined through a total sampling technique. The research uses the one-group pretest-posttest design. The instrument in this study is a bleep test. Based on the test analysis, the tcount value obtained was 2,371, and the ttable value obtained was 1,833. These values indicate that the tcount value is greater than the ttable at a 0,05 sig. value. The results of this study can conclude a significant influence of interval training exercises on high school basketball players' endurance. The determinant value of endurance is 67% contribution. Thus, high-intensity interval training significantly increases the  $VO_{2max}$  endurance capacity.

**To cite this article:** Adila, F., Ittaqwa., Khozin, M., Fatihin, K., & Purnomo, T. J. (2023). Effects of interval training on the  $VO_{2max}$  work of the basket player. *Journal of Coaching and Sports Science*, 2(1), 31-37. <https://doi.org/10.58524/jcss.v2i1.218>

This article is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/) ©2023 by author/s

## INTRODUCTION

Basketball is a sport that has a planned construction and development process. It is sustainable with the support of science and technology. The issue of improving performance in sports in Indonesia will take a long time (Lukyani & Agustina, 2020; Siswoyo et al., 2020). Athletes need to do four things as follows: (1) physical build-up, (2) technical build-up, (3) mental build-up, and (4) Championship (Haugen et al., 2019; Messias et al., 2014).

Generally, players have different maximum  $VO_{2max}$  capacities. Some players have less than 60 ml/kg/min. Some others also have more than 90/ml/ kg/min. The differences are influenced by 1) heart function, 2) muscle metabolism, 3) body-mass index, 4) exercise habits, and 5) heredity. (Klevjer et al., 2023; Samson et al., 2022; Yoo et al., 2023). Besides, the basketball game has to be bounded with a prime  $VO_{2max}$  endurance. A basketball player with good category endurance will have a good mental, social, and spiritual attitude during the game. Basketball players with high endurance are not easily bent and have high concentration (Orione et al., 2021; Soares et al., 2020). Therefore, physical condition, especially endurance, needs to be improved and trained every basketball player (Torres-Unda et al., 2013) continuously.

Physical fitness is one of the most important priorities for enhancing an athlete's performance (Boergers & Gingerelli, 2021). Physical fitness training programs must be well planned and systematic and specifically designed to improve the physical freshness and functional ability of the body system, thus enabling the athlete to good performance (Ma et al., 2023). Physical conditions can affect optimum achievement. The physical condition includes (1) strength, (2) endurance, (3) muscular explosive power, (4) speed, (5) flexibility, (6) balance, and (7) coordination (Hook & Newland, 2018; Rani, 2021; Rodrigues Marques et al., 2016).

In basketball, one of the dominant components of physical conditioning is endurance (Prakoso & Sugiyanto, 2017). Endurance is the individual's ability to adapt to survive for a certain

### Corresponding author:

Adila F., Universitas Riau, Indonesia. ✉ [fekie.adila@lecturer.unri.ac.id](mailto:fekie.adila@lecturer.unri.ac.id)

period. A basketball player must have good endurance to survive and counterattack faster and more efficiently. Endurance is also the ability of the body to carry out loading as long as possible, both statically and dynamically, without decreasing the quality of work. According to Lutan Dalam (Moore et al., 2016), interval training is a form of training method that combines the implementation of workloads for a fairly short time and is interspersed with rest periods between each opportunity. The interval method is carried out with an interval between training and rest (Christy et al., 2022).

One of the exercises that can increase endurance is interval training (Feuerbacher & Schumann, 2023; Gibala et al., 2019; Hoffmann et al., 2021; Ruiz-Alias et al., 2021). This exercise is highly recommended by some experts in increasing Vo2max endurance. Interval training is an exercise program consisting of repetition periods of work interspersed with rest periods (Karlsen et al., 2017). This exercise is characterized by an interlude variation in the form of short rest periods (Ma et al., 2023). The ideality of Vo2max endurance training in the form of interval training includes several physical conditions in the form of strength, speed, flexibility, and agility (Christy et al., 2022).

Several studies related to interval training on increasing endurance were conducted by Macinnis & Gibala, who found that interval training provides normal pressure at high and medium intensity. The data came from 72 volunteers who were studied from each branch of cycling and aerobic sports. They all have stable intensity (MacInnis & Gibala, 2017). In addition, Christy's research on basketball players who were trained specifically to increase endurance through interval training resulted in an increase of 64% in the good category, 75.19% in the excellent category, and only 12% in the moderate category (Christy et al., 2022). A similar study by Kumari looks at the effects of high-intensity interval training on basketball players' aerobic capacity and sport-specific skills. He found that 5-week HIIT training improves aerobic capacity and sport-specific skills and can be included as part of a training regime to improve athletic performance in football players (Kumari et al., 2023). Based on previous research, no research has examined more deeply related to high-intensity interval training exercises for basketball players. It is necessary to research interval training exercises and how much interval training contributes to endurance when doing basketball game activities.

## METHOD

This study used an experimental method with a one-group pretest-posttest design. This method can be used to conduct experiments to find causes and effects or the influence of another variable (Sugiyono, 2018).

**Table 1.** Research Design

<i>Pretest</i>	<i>Treatment/ Exercise</i>	<i>Post Test</i>
<i>(O1) Bleep Tes</i>	<i>(X) Interval Training</i>	<i>(O2) Bleep Test</i>

### Information:

**O1** = Pretest Value (preliminary test / before being given practice)

**X** = Treatment

**O2** = Posttest Value (final test / after being given practice)

The population in this study were ten members of the men team of As-Shofah Pekanbaru high school basketball players. The sample was the entire population because the sampling technique used was the total sampling technique. The quantitative data was used to measure units of time to obtain the effect of interval training, the researchers used the bleep test as the research instrument. The bleep test was used to measure running back and forth in a distance of 20 meters in a certain period measured using a stopwatch. The back-and-forth running activity was carried out for 1 minute following a regular "tut" sound. Participants were expected to follow the "tut" sound at intervals. The interval between the two "tut" sounds decreased when the time reached one minute. The speed in the first minute is called level 1, and so on up to 21.

The data collection technique used a pretest which was carried out at the beginning of the meeting, and a posttest which was carried out in 16<sup>th</sup> meetings. The analysis was performed quantitatively with statistical testing. The procedure is to calculate each test's average and standard deviation, carry out the Lilliefors normality test, and the sample's mean difference test (t-test). The following is research procedure.

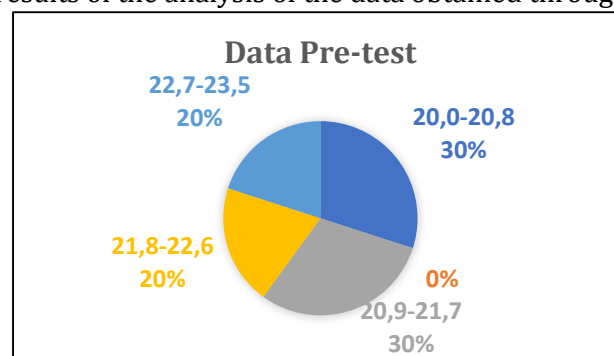


**Figure 1.** Research Procedure

## RESULTS AND DISCUSSION

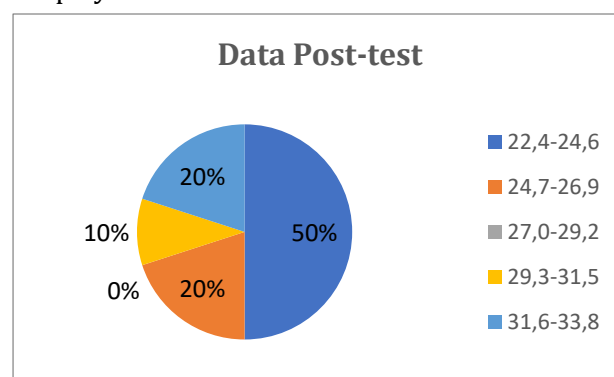
### Result

Following are the results of the analysis of the data obtained through the test:



**Figure 2.** Percentage Data of the Pre-test

Based on the study's results, there are differences and an increase in the endurance of high school basketball players. At the beginning of the test, the player's endurance was at a very weak state. In contrast, after being treated for approximately 1.5 months, the final test obtained significant results where the player's endurance increased.



**Figure 3.** Percentage Data of the Post-test

The analysis shows that 50% players were in the excellent category. In the second category, two players (20%) were in the range of 24.7-26.9 in the high category. No players were in the third category. In the fourth category, in the range 29.3-31.5, there was one (10%) player in the low category. In the fifth category, there were two (20%) players in the poor category.

Based on the diagram above, there are differences and an increase in the endurance of high school basketball players. At the beginning of the test, the player's endurance was still in a very

poor state. In contrast, after being treated for approximately 1.5 months, the final test obtained significant improvement results where the player's endurance increased.

The results of the normality test using the Lilliefors formula on the research variables, namely interval training (X) and endurance (Y), can be seen in Table 2.

**Table 2.** The Result of the Normality Test

Variable	L <sub>count</sub>	L <sub>table</sub>
<i>The results of the pretest</i>	<b>0,167</b>	<b>0,258</b>
<i>The results of the posttest</i>	<b>0,117</b>	<b>0,258</b>

Table 2 shows the data from the pretest produced an L<sub>count</sub> value of 0.167 and an L<sub>table</sub> value of 0.258. It means that L<sub>count</sub> is smaller than L<sub>table</sub>. It can be concluded that the data was normally distributed. The posttest yielded an L<sub>count</sub> value of 0.117, which was smaller than the L<sub>table</sub> of 0.258. therefore, it can be concluded that the posttest was normally distributed.

The hypothesis test using the t-test formula produced a t<sub>count</sub> value of 2.371 and a t<sub>table</sub> value of 1.833. It can be concluded that H<sub>a</sub> was accepted. Therefore, there was an effect of interval training on the endurance of As-Shofa Pekanbaru high school basketball players.

The hypothesis tested in this study was the effect of interval training on the endurance of As-Shofa Pekanbaru high school basketball players. The data obtained were analyzed descriptively, then the research hypothesis was tested, which was proposed according to the problem: "There is an effect of interval training on the endurance of As-Shofa Pekanbaru High School Basketball players. The t-test analysis produces a t<sub>count</sub> value of 2.371 and a t<sub>table</sub> table value of 1.833. It can be concluded that H<sub>a</sub> is accepted.

From the analysis above, it can be concluded that interval training affected the endurance of As-Shofa Pekanbaru high school basketball players at the alpha ( $\alpha$ ) level of 0.05 with a 95% confidence level.

## Discussion

The interval training pattern was applied to As-Shofa Pekanbaru High School Basketball players. There was an increase in athletes' endurance, even though minimum. It means that every exercise carried out increased in the results achieved. Training is a repetitive process that increases the potential to achieve maximum performance. The t-test yielded a t<sub>count</sub> value of 2.381 with t<sub>table</sub> value of 1.833. Therefore, H<sub>a</sub> was accepted at the alpha level ( $\alpha$ ) of 0.05. It can be concluded that there was an effect of interval training on the endurance of high school basketball players.

Based on the results above, it is clear that the interval training improved players' endurance (Runacres et al., 2019). However, many other forms of exercise can increase endurance, as already explained in the background of the problem. The researcher also explained that the exercises followed the training program that had been prepared. The weakness of researchers was that they could not control what athletes do after conducting the research.

Judging from basketball players' needs, they consume a lot of Vo2max oxygen. Even though the players' muscles are very relevant, oxygen consumption is needed so that their red blood is active higher than their white blood (Scott et al., 2019). Besides, basketball players are also expected to have injuries (Salido et al., 2023; Scott et al., 2019). Endurance can be developed through relatively few exercises. Some experts find renewal of increased endurance (Vasquez-Bonilla, et al, 2022).

This research is relevant to previous research conducted by Festiawan, namely High-intensity interval training and fartlek training: The effect on the VO2 Max level in increasing Vo2max in athletes (Festiawan et al., 2020). Furthermore, Festiawan conveyed the results of statistical calculations in testing the third hypothesis in the study showing that the interval training treatment had no better effect than Fartlek training on cardiovascular endurance in male Junior athletes (Festiawan et al., 2020). Thus, both exercises are equally good; however, the interval training is not better than fartlek training.

Based on the results obtained from the pretest, athletes were then given regular training for approximately 1.5 months. Then proceed with the posttest. It can be seen that the eighth athletes were in a low category before carrying out the exercise. After doing the exercise, five were in the

high category, two are in the medium category, and one in the low category. So the researchers concluded that interval training exercises can be used to increase endurance.

The researchers suggest that from a number of training methods used to support training, the ideal exercise is interval training. This exercise does not require a lot of equipment. From several literature, interval training has been widely used in training, both in sports and performance training. The limitations of this study is the small sample size. Therefore, it is necessary to have a large sample in further research. The research object is focused on only two variables when collecting data, information, and delivery. Still, there are several obstacles to implementation, namely, respondents often ask for additional recovery hours, and the distance used is not following existing theory.

### CONCLUSION

From the results of research done with the data analysis process, the researchers concluded that interval training showed an influence between the two variables on endurance training in basketball athletes. High-intensity interval training significantly improves basketball player endurance. Therefore, training to increase endurance should be given more programs to achieve optimal performance. A good increase in endurance also contributes to the realization of match strategies.

### AUTHOR CONTRIBUTION STATEMENT

FA made an overview of Vo2max durability and improved the arrangement of article content. ITQ helped find the latest references. MK and KF looked for data and analyze so that the results are obtained in the form of merging the two variables. TJP rearranges the article according to the template in the JCSS journal.

### REFERENCES

- Boergers, R., & Gingerelli, A. (2021). *Finish strong: Resistance training for endurance athletes*. Bloomsbury Publishing. <https://books.google.co.id/books?id=utFBEEAAQBAJ>
- Christy, B. E., Raharjo, S., Andiana, O., & Yunus, M. (2022). Pengaruh latihan circuit dan interval training terhadap peningkatan daya tahan VO2max pada anggota ekstrakurikuler bola basket SMK Negeri 3 Malang. *Sport Science and Health*, 4(10), 909-916. <https://doi.org/10.17977/um062v4i102022p909-916>
- Festiawan, R., Suharjana, S., Priyambada, G., & Febrianta, Y. (2020). High intensity interval training dan fartlek training: Pengaruhnya terhadap tingkat VO2 Max. *Jurnal Keolahragaan*, 8(1), 9-20. <https://doi.org/10.21831/jk.v8i1.31076>
- Feuerbacher, J. F., & Schumann, M. (2023). High-intensity interval training and resistance training for endurance athletes. In *Endurance Sports Medicine* (pp. 355-372). Springer International Publishing. [https://doi.org/10.1007/978-3-031-26600-3\\_21](https://doi.org/10.1007/978-3-031-26600-3_21)
- Gibala, M. J., Bostad, W., & McCarthy, D. G. (2019). Physiological adaptations to interval training to promote endurance. *Current Opinion in Physiology*, 10, 180-184. <https://doi.org/10.1016/j.cophys.2019.05.013>
- Haugen, T., Seiler, S., Sandbakk, Ø., & Tønnessen, E. (2019). The training and development of elite sprint performance: an integration of scientific and best practice literature. *Sports Medicine - Open*, 5(1), 44. <https://doi.org/10.1186/s40798-019-0221-0>
- Hoffmann, S., Skinner, T. L., van Rosendal, S. P., Emmerton, L. M., & Jenkins, D. G. (2021). Comparison of training responses and performance adaptations in endurance-trained men and women performing high-intensity interval training. *Journal of Sports Sciences*, 39(9), 1010-1020. <https://doi.org/10.1080/02640414.2020.1853960>
- Hook, R., & Newland, A. (2018). A basic needs coaching paradigm for coaches of intercollegiate and high school athletes. *Journal of Sport Psychology in Action*, 9(3), 182-195. <https://doi.org/10.1080/21520704.2018.1463328>
- Karlsen, T., Aamot, I.-L., Haykowsky, M., & Rognmo, Ø. (2017). High intensity interval training for maximizing health outcomes. *Progress in Cardiovascular Diseases*, 60(1), 67-77. <https://doi.org/10.1016/j.pcad.2017.03.006>



- Klevjer, M., Nordeidet, A. N., & Bye, A. (2023). The genetic basis of exercise and cardiorespiratory fitness - relation to cardiovascular disease. *Current Opinion in Physiology*, 33, 100649. <https://doi.org/10.1016/j.cophys.2023.100649>
- Kumari, A., Singh, P., & Varghese, V. (2023). Effects of high-intensity interval training on aerobic capacity and sports-specific skills in basketball players. *Journal of Bodywork and Movement Therapies*, 34, 46-52. <https://doi.org/10.1016/j.jbmt.2023.04.032>
- Lukyani, L., & Agustina, R. S. (2020). *Buku jago bola basket*. Cemerlang. <https://books.google.co.id/books?id=7tn0DwAAQBAJ>
- Ma, X., Cao, Z., Zhu, Z., Chen, X., Wen, D., & Cao, Z. (2023). VO2max (VO2peak) in elite athletes under high-intensity interval training: A meta-analysis. *Heliyon*, 9(6), e16663. <https://doi.org/10.1016/j.heliyon.2023.e16663>
- MacInnis, M. J., & Gibala, M. J. (2017). Physiological adaptations to interval training and the role of exercise intensity. *The Journal of Physiology*, 595(9), 2915-2930. <https://doi.org/10.1113/JP273196>
- Messias, L. H. D., dos Reis, I. G. M., Ferrari, H. G., & de Barros Manchado-Gobatto, F. (2014). Physiological, psychological and biomechanical parameters applied in canoe slalom training: a review. *International Journal of Performance Analysis in Sport*, 14(1), 24-41. <https://doi.org/10.1080/24748668.2014.11868700>
- Moore, S. C., Lee, I. M., Weiderpass, E., Campbell, P. T., Sampson, J. N., Kitahara, C. M., Keadle, S. K., Arem, H., De Gonzalez, A. B., Hartge, P., Adami, H. O., Blair, C. K., Borch, K. B., Boyd, E., Check, D. P., Fournier, A., Freedman, N. D., Gunter, M., Johannson, M., Patel, A. V. (2016). Association of leisure-time physical activity with risk of 26 types of cancer in 1.44 million adults. *JAMA Internal Medicine*, 176(6), 816-825. <https://doi.org/10.1001/jamainternmed.2016.1548>
- Orione, L., Fleith, D. de S., & Veloso, F. (2021). The role of psychosocial support training in sports talent development. *Gifted and Talented International*, 36(1-2), 102-114. <https://doi.org/10.1080/15332276.2021.1953418>
- Prakoso, G. P. W., & Sugiyanto, F. (2017). Pengaruh metode latihan dan daya tahan otot tungkai terhadap hasil peningkatan kapasitas VO2Max pemain bola basket. *Jurnal Keolahragaan*, 5(2), 151. <https://doi.org/10.21831/jk.v5i2.10177>
- Rani, R. (2021). *Physical fitness and wellness*. Friends Publications (India). <https://books.google.co.id/books?id=QfMuEAAAQBAJ>
- Rodrigues Marques, R. F., Nunomura, M., & Pombo Menezes, R. (2016). Sports coaching science in Brazil. *Sports Coaching Review*, 5(2), 132-137. <https://doi.org/10.1080/21640629.2016.1198453>
- Ruiz-Alias, S. A., García-Pinillos, F., Soto-Hermoso, V. M., & Ruiz-Malagón, E. J. (2021). Heart rate monitoring of the endurance runner during high intensity interval training: Influence of device used on training functions. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, 175433712110370. <https://doi.org/10.1177/17543371211037035>
- Runacres, A., Mackintosh, K. A., & McNarry, M. A. (2019). The effect of constant-intensity endurance training and high-intensity interval training on aerobic and anaerobic parameters in youth. *Journal of Sports Sciences*, 37(21), 2492-2498. <https://doi.org/10.1080/02640414.2019.1644890>
- Salido, A., López-Vidriero, R., Arteaga, R. F., Halcón, M., & López-Vidriero, E. (2023). Successful outcomes after surgical treatment of chronic complete proximal hamstring avulsions in female athletes older than 55 years. *Apunts Sports Medicine*, 58(218), 100412. <https://doi.org/10.1016/j.apunsm.2023.100412>
- Samson, R., Ennezat, P. V., Le Jemtel, T. H., & Oparil, S. (2022). Cardiovascular disease risk reduction and body mass index. *Current Hypertension Reports*, 24(11), 535-546. <https://doi.org/10.1007/s11906-022-01213-5>
- Scott, S. N., Shepherd, S. O., Hopkins, N., Dawson, E. A., Strauss, J. A., Wright, D. J., Cooper, R. G., Kumar, P., Wagenmakers, A. J. M., Cocks, M., Powers, S., & Hamilton, K. (2019). Home-hit improves muscle capillarisation and eNOS / NAD ( P ) Hoxidase protein ratio in obese

- individuals with elevated cardiovascular disease risk. *16*, 4203-4225.  
<https://doi.org/10.1113/JP278062>
- Siswoyo, J., Cahyadi, A., & Wicaksono, L. (2020). Manajemen Persatuan Bola Basket Seluruh Indonesia (PERBASI) Kabupaten Tanggamus. *Journal Sport Area*, *5*(2), 215-225.  
[https://doi.org/10.25299/sportarea.2020.vol5\(2\).5219](https://doi.org/10.25299/sportarea.2020.vol5(2).5219)
- Soares, A. L. A., Leonardi, T. J., Silva, J., Nascimento, J. V., Paes, R. R., Gonçalves, C. E., & Carvalho, H. M. (2020). Performance, motivation, and enjoyment in young female basketball players: An interdisciplinary approach. *Journal of Sports Sciences*, *38*(8), 873-885.  
<https://doi.org/10.1080/02640414.2020.1736247>
- Sugiyono. (2018). *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D)*. Alfabeta.
- Torres-Unda, J., Zarrasquin, I., Gil, J., Ruiz, F., Irazusta, A., Kortajarena, M., Seco, J., & Irazusta, J. (2013). Anthropometric, physiological and maturational characteristics in selected elite and non-elite male adolescent basketball players. *Journal of Sports Sciences*, *31*(2), 196-203.  
<https://doi.org/10.1080/02640414.2012.725133>
- Vasquez-bonilla, A. A., Rojas-Valverde, D., Timon, R., & Olcina, G. (2022). Influence of fat percentage on muscle oxygen uptake and metabolic power during repeated-sprint ability of footballers. *Apunts Sports Medicine*, *57*(216), 100395. <https://doi.org/10.1016/j.apunsm.2022.100395>
- Yoo, J. E., Han, K., Jung, J., Hur, Y., Kim, Y. H., Kim, E. S., Son, J. W., Rhee, E., Lee, W., & Nam, G. E. (2023). Body mass index, waist circumference and cardiovascular diseases in transitional ages (40 and 66 years). *Journal of Cachexia, Sarcopenia and Muscle*, *14*(1), 369-381.  
<https://doi.org/10.1002/jcsm.13138>