Bravo's: Journal of Physical Education and Sport Science
Volume 13 Issue 2, Mei 2025, pp: 333-340
E-ISSN: 2597-677X; P-ISSN: 2337-7674
DOI: http://dx.doi.org/10.32682/bravos.v13si2/141

The effect of differences in work and rest ratios in high intensity interval training on physical performance

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Abstract

Training is something that athletes need to improve their physical performance. This study aims to examine the differences in the effects of HIIT training with different work and rest ratios on the physical condition of male badminton athletes at university level. The method applied in this study is an experimental method with a matching only design. The sample of this study was 30 male badminton players at university level. The number of samples used was the total number of athletes at the university. The results obtained were that training with a work and rest ratio of 1:1 can have a significant effect on physical condition. In addition, the ratio of 1:2 and 1:3 also has a significant effect on the physical condition of athletes. The conclusion in this study is that there is a difference in the effect between training with a ratio of 1:1, 1:2 and a ratio of 1:3 in improving physical condition, where the ratio of 1:1 has a better effect as one of the options as a training model in preparation before the match.

Keywords: exercise, work, rest, interval, intensity, physical performance

Received: 03 05 2025 Revised: 07 05 2025 Accepted: 13 05 2025

Authors' Contribution: A – Conceptualization; B – Methodology; C – Software; D – Validation; E - Formal analysis; F – Investigation; G – Resources; H - Data Curation; I - Writing - Original Draft; J - Writing - Review & Editing; K – Visualization; L – Supervision; M - Project administration; N - Funding acquisition

INTRODUCTION

Training is a long process experienced by an athlete, (Kusuma et al., 2023). Training means a need that must be carried out by athletes at all times, (Dwi Jayanti et al., 2022). This is the main path to achieving success, (Pierros & Spyrou, 2023). The purpose of training is to improve athlete performance, starting from physical, technical, tactical, mental and strategic, (Zaravar et al., 2024). A trainer makes a list of training programs that will be carried out by athletes. With this program, training will focus on the problems of each athlete. A good training program will help athletes improve their performance during the match, (Gavilán-Carrera et al., 2023).

One of the training models that is currently being discussed a lot is interval training, especially with high intensity. This training is effective in improving athlete performance, (L. Wang et al., 2024a). In addition, it can also significantly improve athlete fitness, (Li et al., 2023). This exercise is widely done because the mechanism of the activity is mostly in accordance with the characteristics of the activity in the sport, (Kusuma et al., 2020). For example, in a cyclical sport such as badminton. In badminton, a player will do an activity when the shuttlecock is in play. Then take a break if the shuttlecock is not in play. This cyclical

condition is active then rest for a while, do activities again then rest for a while again. This cycle is the same basic concept as the High Intensity Interval Training (HIIT) training model, (Zhang et al., 2024). In HIIT training, activities are carried out with high intensity and there are interval breaks between exercises, (Mendonça et al., 2022).

In interval training, the most important thing is setting the ratio between work and rest, (Utomo et al., 2024). Setting this ratio is the main key as a factor in the success of HIIT training, (Rogers et al., 2024). The use of this ratio is a reference for the duration of activity and the duration of rest time. Along with this, other important settings lie in repetitions and sets, (Zhao et al., 2022). By determining the right dose in athlete training, the chances of achieving training goals will be greater. This ratio is still often debated among international journal articles, several studies have different research results regarding the work and rest ratio, (Eisenhut et al., 2022). So the problem of the work and rest ratio in HIIT training is not yet clear and needs a more detailed study.

Based on field data obtained by researchers. The concept of HIIT training with a work and rest ratio is still diverse. Starting from the use of a ratio of 1: 1, 1: 2 and even 1: 3 to improve physical fitness. This shows that there are no definite training guidelines for which ratio is the most effective for improving fitness in athletes. Thus reducing the level of efficiency in implementing athlete physical condition training. Therefore, it is important to conduct a study related to the Influence of Differences in Work and Rest Ratios in High Intensity Interval Training on the Physical Performance of Male Badminton Athletes in College.

METHOD

The subjects of this study were 30 male college badminton athletes. The procedure for collecting VO2 max data used a field test, namely the multi-stage fitness test (MSFT), in addition to a fitness tracker being added to help monitor VO2 max results. Data analysis used a T-test to determine whether there was a significant effect of HIIT training with different training and rest ratios. Data analysis was assisted by Microsoft Excel 2019 and SPSS version 25 software.

RESULT

In experimental group 1, namely the group that received treatment in the form of HIIT training with a 1:1 ratio model, there was a fairly good increase in fitness, namely the average Vo2 max increased from 31 to 40 ml / kg / min.

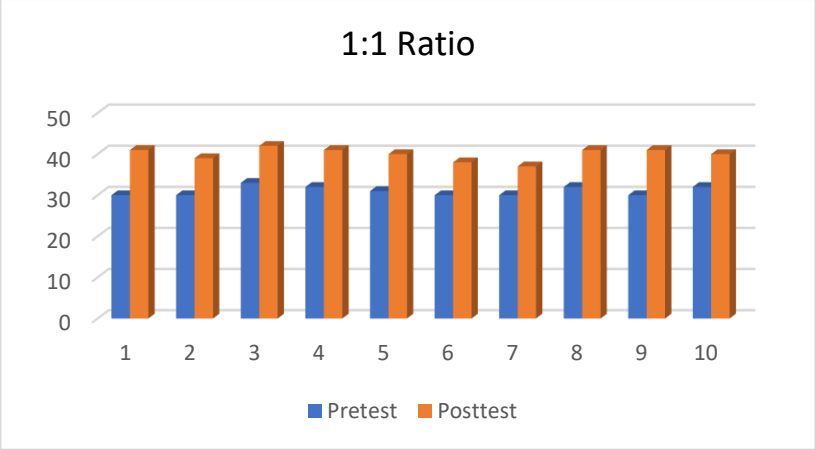


Figure 1. Pre-test post-test data of the experimental group with a ratio of 1:1

While in experimental group 2, namely the HIIT training group with a 1:2 ratio model, there was also an increase in average fitness pretest and posttest, namely from 31 to 37 ml / kg / min.

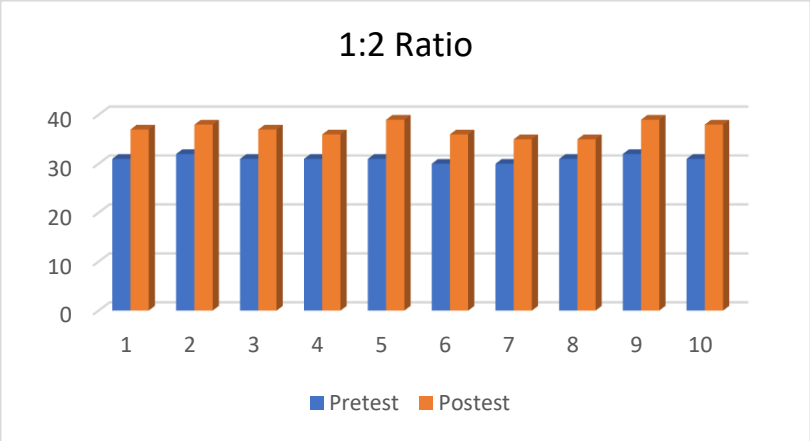


Figure 1. Pre-test post-test data of the experimental group with a ratio of 1:2

However, HIIT training with a 1:3 ratio model had the lowest average increase in fitness, namely 31 to 35 ml / kg / min.

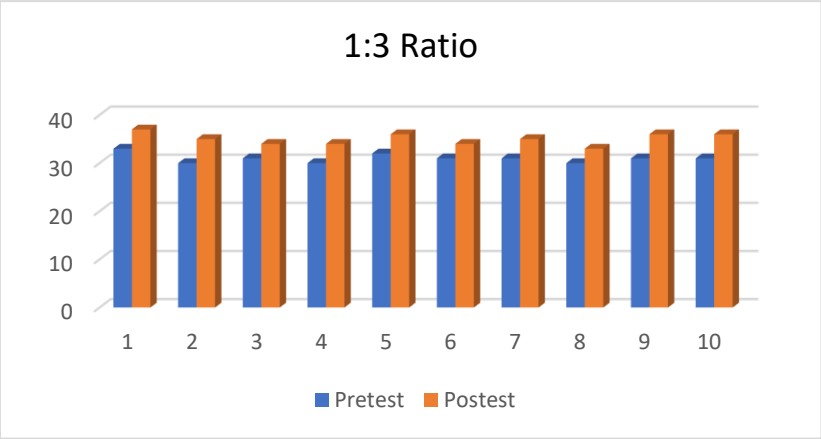
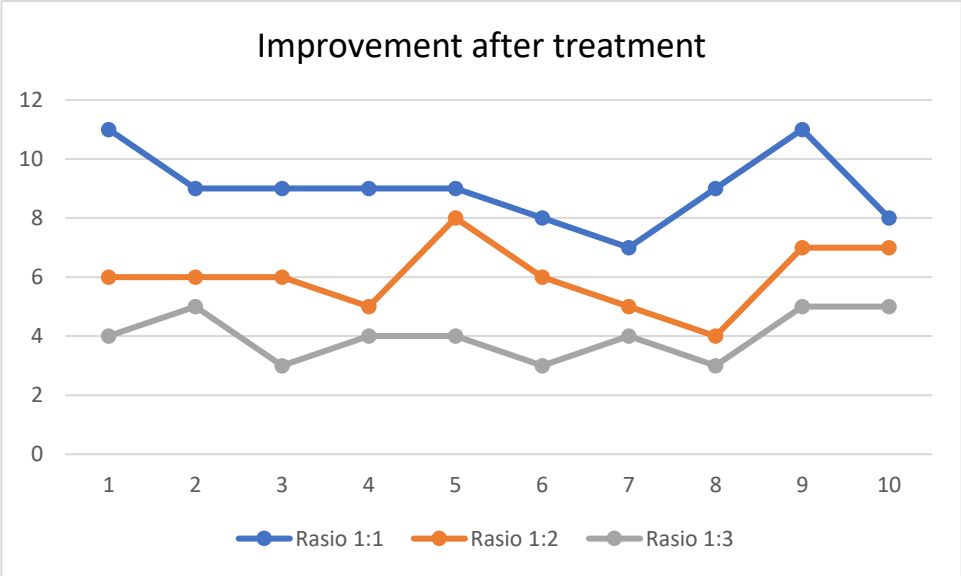


Figure 1. Pre-test post-test data of the experimental group with a ratio of 1:3

The results of this study indicate that the average increase in the HIIT training model with a 1:1 ratio model has the largest average increase of the others, namely 9 ml / kg / min. The second highest increase was HIIT training with a 1:2 ratio model with an average increase of 6 ml / kg / min. The last average increase was HIIT training with a 1:3 ratio, namely an average increase of 4 ml / kg / min.



DISCUSSION

HIIT training with a 1:1 ratio is the highest intensity training in this study when compared to other groups. This is because the rest time is the same as the training time performed, (Luo et al., 2023). This certainly provides a high stressor to the body from the cardiovascular system to the respiratory system, (Lan et al., 2022). The body's metabolism, especially in providing energy and distributing oxygen, occurs quickly during training conditions, (Cabrera et al., 2021). While during the rest period, the body is required to recover as quickly as possible because the rest time is limited so that the athlete's body performance increases, especially in the vo2 max aspect, (Mateo-Orcajada et al., 2024). HIIT training with a 1:2 ratio model is one option as a training that can improve athlete performance, (X. Wang et al., 2024). This training model is based on a rest time that is 2 times more than the training time. This allows the body to rest longer so that energy provision can take place more optimally but the stressor given to the body is not as high as in training with a 1:1 ratio, (Wittels et al., 2023). This is what causes training with a 1:2 ratio to have a lower impact than HIIT training with a 1:1 ratio.

The next training model is HIIT training with a 1:3 ratio. This exercise has the characteristic of a rest time that is 3 times greater than the rest time. In training with this model, the rest time is too long so that the body's heart rate is not in the training zone, so this exercise gets the smallest increase in performance than other training models, (Feng et al., 2024). If the heart rate is not in the training zone, the body cannot respond to it as training because the stressor or load on the body is too low or lacking so that it has a less than optimal impact, (Xu et al., 2024).

So the important point of the difference between the several ratio models above lies in the rest period given during training. It turns out that the results of this study prove that providing different rest periods has different impacts on athlete performance (Wen et al., 2022). This indicates that the heavier the training load given to the body, the greater the impact on the body (Maciel et al., 2022). However, of course, the burden given here must be adjusted to the characteristics of the athlete such as age, gender, sport level, and living environment (Ferri-Caruana et al., 2022). Similar research supports the results of the study that training for 8 weeks with a 1:1 ratio interval can improve athlete performance (Kusuma et al., 2020). The use of the right work and rest ratio will determine how far an athlete's goals are achieved (Zhang et al., 2024). In HIIT training, the most important thing is the use of the work and rest ratio interval as a basic foundation for systematically loading the body (Rogers et al., 2024). Meanwhile, research that is contrary to this research is that low intensity training is an exercise that can be a successor for someone to improve their performance, (L. Wang et al., 2024b). Resistance training is an exercise to improve fitness, in this study it emphasizes weight training to improve body performance, (Xavier et al., 2020).

CONCLUSIONS

There is a significant effect between high intensity interval training with work and rest ratios of 1:1, 1:2, and 1:3 on the physical condition of male badminton athletes at university level. In addition, high intensity interval training with a work and rest ratio of 1:1 has been scientifically proven to be the most effective training to improve physical condition.

REFERENCES

Cabrera, A. M. Z., Soto, M. J. C., Aranzales, J. R. M., Valencia, N. M. C., & Gutiérrez, M. P. A. (2021). Blood lactate concentrations and heart rates of Colombian Paso horses during a field exercise test. Veterinary and Animal Science, 13. https://doi.org/10.1016/j.vas.2021.100185

Dwi Jayanti, S., Nuryadi, A., Kusuma, A. I., & Pieter Pelamonia, S. (2022). The Impact Of Double Tuck Jump and Lunge Jump On The High Jump Increases. Jurnal Ilmiah ADIRAGA, 8(2), 49–59. https://doi.org/10.36456/adiraga

Eisenhut, L., Sadeghi-Bahmani, D., Seamann, A., Staub, L., Brand, S., & Cordier, D. (2022). Effects of two types of exercise training on psychological well-being, sleep and physical fitness in patients with high-grade glioma (WHO III and IV). Journal of Psychiatric Research, 151, 354–364. https://doi.org/10.1016/j.jpsychires.2022.03.058

Feng, W., Wang, F., Han, Y., & Li, G. (2024). The effect of 12-week core strength training on dynamic balance, agility, and dribbling skill in adolescent basketball players. Heliyon, e27544. https://doi.org/10.1016/j.heliyon.2024.e27544

Ferri-Caruana, A., Mollà-Casanova, S., Baquedano-Moreno, M., & Serra-Añó, P. (2022). Electromyographic activity of posterior kinetic chain muscles during hamstring strengthening exercises. Physical Therapy in Sport, 55, 205–210. https://doi.org/10.1016/j.ptsp.2022.04.008

Gavilán-Carrera, B., Borges-Cosic, M., Álvarez-Gallardo, I. C., Soriano-Maldonado, A., Acosta-Manzano, P., Camiletti-Moirón, D., Carbonell-Baeza, A., Casimiro, A. J., Girela-Rejón, M. J., Walitt, B., & Estévez-López, F. (2023). Effectiveness of Land- and Water-based Exercise on Fatigue and Sleep Quality in Women With Fibromyalgia: The al-Ándalus Quasi-Experimental Study. Archives of Physical Medicine and Rehabilitation, 104(11), 1775–1784. https://doi.org/10.1016/j.apmr.2023.04.028

Kusuma, A. I., Putra, I. B., & Utamayasa, I. G. D. (2023). Efektifitas Teknologi Sensor Alat Olahraga Neuro Dance pada Simulator dengan Menggunakan Smart Watch terhadap Heart Rate, Tekanan Darah dan Pencegahan Resiko Obesitas. Jurnal Pendidikan Kesehatan Rekreasi, 9(2), 217–224. https://doi.org/10.5281/zenodo.8088193

Kusuma, A. I., Setijono, H., & Mintarto, E. (2020). Effects of Jump Rope and High Jump Training with 1:1 Intervals on Increasing Vo2 Max and Anaerobic Threshold. In International Journal of Innovation, Creativity and Change. www.ijicc.net (Vol. 12, Issue 6). www.ijicc.net

Lan, C., Liu, Y., & Wang, Y. (2022). Effects of different exercise programs on cardiorespiratory fitness and body composition in college students. Journal of Exercise Science and Fitness, 20(1), 62–69. https://doi.org/10.1016/j.jesf.2021.12.004

Li, G., Wu, W., Zhen, K., Zhang, S., Chen, Z., Lv, Y., Hou, X., & Yu, L. (2023). Effects of different drop height training on lower limb explosive and change of direction performance in collegiate Sanda athletes. IScience, 26(10). https://doi.org/10.1016/j.isci.2023.107972

Luo, Y. X., Zhu, Y. H., & Yao, X. Q. (2023). Knowledge mapping of exercise and physical activity research in older adults: Hotspots, bursts, and trends of the last decade. Heliyon, 9(12). https://doi.org/10.1016/j.heliyon.2023.e23181

Maciel, F. O., Miranda, R., Ferreira-Júnior, J. B., Goulart, T., Brandão, F., Werneck, F. Z., & Bara-Filho, M. G. (2022). Analysis of different training load monitoring methods in youth women handball players. Apunts Sports Medicine, 57(215). https://doi.org/10.1016/j.apunsm.2022.100381

Mateo-Orcajada, A., Vaquero-Cristóbal, R., & Abenza-Cano, L. (2024). Importance of training volume through the use of step trackers apps promoted from the subject of physical

education to change body composition, physical fitness and physical activity in adolescents and the influence of gender☆,☆☆. Physiology and Behavior, 273. https://doi.org/10.1016/j.physbeh.2023.114402

Mendonça, F. R., Ferreira de Faria, W., Marcio da Silva, J., Massuto, R. B., Castilho dos Santos, G., Correa, R. C., Ferreira dos Santos, C., Sasaki, J. E., & Neto, A. S. (2022). Effects of aerobic exercise combined with resistance training on health-related physical fitness in adolescents: A randomized controlled trial. Journal of Exercise Science and Fitness, 20(2), 182–189. https://doi.org/10.1016/j.jesf.2022.03.002

Pierros, T., & Spyrou, K. (2023). Effects of high-intensity interval training versus sprint interval training during the second wave of COVID-19 lockdown on soccer players. Apunts Sports Medicine, 58(218). https://doi.org/10.1016/j.apunsm.2023.100414

Rogers, T., Gill, N., & Beaven, C. M. (2024). A comparison of three different work to rest periods during intermittent sprint training on maintaining sprint effort performance. Journal of Exercise Science and Fitness, 22(2), 97–102. https://doi.org/10.1016/j.jesf.2023.12.004

Utomo, G. M., Kusuma, A. I., Utamayasa, I. G. D., Putra, I. B., & Zen, M. Z. (2024). Efektivitas Latihan Vertimax jump dan Modern Depth jump terhadap Peningkatan Kecepatan dan Power. Jurnal Pendidikan Kesehatan Rekreasi, 10(1), 176–183. https://doi.org/10.59672/jpkr.v10i1.3481

Wang, L., Wang, X., Chen, J., Liu, Y., Wang, G., Chen, L., Ni, W., Jia, Y., Dai, C., Shao, W., & Liu, B. (2024a). Low-intensity exercise training improves systolic function of heart during metastatic melanoma-induced cachexia in mice. Heliyon, 10(4). https://doi.org/10.1016/j.heliyon.2024.e25562

Wang, L., Wang, X., Chen, J., Liu, Y., Wang, G., Chen, L., Ni, W., Jia, Y., Dai, C., Shao, W., & Liu, B. (2024b). Low-intensity exercise training improves systolic function of heart during metastatic melanoma-induced cachexia in mice. Heliyon, 10(4). https://doi.org/10.1016/j.heliyon.2024.e25562

Wang, X., Soh, K. G., Deng, N., Zhang, D., Cao, S., & Samsudin, S. (2024). Effects of functional training on muscle strength, jumping, and functional movement screen in wushu athletes: A systematic review. Heliyon, 10(2). https://doi.org/10.1016/j.heliyon.2024.e24087

Wen, H. J., Liu, S. H., & Tsai, C. L. (2022). Effects of 12 weeks of aerobic exercise combined with resistance training on neurocognitive performance in obese women. Journal of Exercise Science and Fitness, 20(4), 291–304. https://doi.org/10.1016/j.jesf.2022.07.001

Wittels, S. H., Renaghan, E., Wishon, M. J., Wittels, H. L., Chong, S., Wittels, E. D., Hendricks, S., Hecocks, D., Bellamy, K., Girardi, J., Lee, S., McDonald, S., & Feigenbaum, L. A. (2023). Recovery of the autonomic nervous system following football training among division I collegiate football athletes: The influence of intensity and time. Heliyon, 9(7). https://doi.org/10.1016/j.heliyon.2023.e18125

Xavier, V. B., Avanzi, O., de Carvalho, B. D. M. C., & Alves, V. L. dos S. (2020). Combined aerobic and resistance training improves respiratory and exercise outcomes more than aerobic training in adolescents with idiopathic scoliosis: a randomised trial. Journal of Physiotherapy, 66(1), 33–38. https://doi.org/10.1016/j.jphys.2019.11.012

Xu, Y., Liu, X., Tsuji, K., Hamaoka, T., & Tabata, I. (2024). Oxygen uptake during the last bouts of exercise incorporated into high-intensity intermittent cross-exercise exceeds the

V˙ O2max of the same exercise mode. Sports Medicine and Health Science, 6(1), 63–69. https://doi.org/10.1016/j.smhs.2024.01.002

Zaravar, F., Tamaddon, G., Zaravar, L., & Koushkie Jahromi, M. (2024). The effect of aquatic training and vitamin D3 supplementation on bone metabolism in postmenopausal obese women. Journal of Exercise Science and Fitness, 22(2), 127–133. https://doi.org/10.1016/j.jesf.2024.01.002

Zhang, Z., Xie, L., Ji, H., Chen, L., Gao, C., He, J., Lu, M., Yang, Q., Sun, J., & Li, D. (2024). Effects of different work-to-rest ratios of high-intensity interval training on physical performance and physiological responses in male college judo athletes. Journal of Exercise Science and Fitness, 22(3), 245–253. https://doi.org/10.1016/j.jesf.2024.03.009

Zhao, Y., Qin, C., Shu, D., & Liu, D. (2022). Effects of short-term aerobic exercise on creativity. Thinking Skills and Creativity, 44. https://doi.org/10.1016/j.tsc.2022.101033