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Evaluation of a 1:¾ work-to-rest interval training program at 100% vo₂ max intensity

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ABSTRACT

Background. The accuracy in timing the ratio of exercise to rest durations during interval training affects athletes' performance and success in completing their training programs. Therefore, when designing a training program, a coach must ensure synchronization between training objectives and the application of training loads, such as exercise intensity. This study contributes new evidence regarding the relationship between work-to-rest ratio, training intensity, and interval training performance. **Objective.** This study aims to determine the level of achievement of a 100% intensity interval training program with a work-to-rest ratio of 1:¾. **Method.** This study used a survey to determine the level of achievement of the interval training program with a 1:¾ ratio. The research design was quantitative and descriptive, and the research instruments used were the Balke test to measure VO_2 max and interval training. The study population consisted of basketball athletes from the Central Java Student Sports Education and Training Center, with a sample size of nine athletes. **Results.** The results showed that 8 athletes achieved a 100% completion rate, 1 athlete achieved an 87% completion rate, and the average completion rate was 99%. **Conclusion.** Athletes were able to perform 400-meter interval training at 100% intensity with a training volume approaching twice the distance of the VO_2 max test; however, since each athlete has different physical conditions, the training must be adjusted to each athlete's individual capabilities. The implications of this study for coaches are that it serves as a reference for developing measurable interval training programs to improve endurance, thereby preventing overtraining caused by excessively heavy training loads.

Key words: Interval training; intensity; VO_2 max.

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INTRODUCTION

The training pyramid for achieving performance consists of physical, technical, tactical, and mental training; however, physical condition is the most fundamental factor (Kusuma et al., 2024). There are 10 components of physical fitness that athletes must possess to be able to carry out training programs efficiently and achieve high performance: endurance, strength, power, speed, agility, flexibility, balance, coordination, accuracy, and reaction time (Dhuha et al., 2023; Kadir et al., 2022). Among these physical fitness components, one serves as the foundation for training the others: endurance (Nubatonis et al., 2024; Suniga et al., 2025).

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Endurance is crucial for athletes to maintain movement throughout a match without experiencing fatigue (Asmara et al., 2023). Therefore, a well-structured, measurable endurance training program tailored to the athlete's capabilities is essential. Physical fitness—particularly endurance—is a key determinant of victory when competing athletes possess comparable technical skills (Dhuha et al., 2023). Interval training, fartlek, and continuous training are some of the training methods used to improve endurance (Dhuha, Yogaswara, Abubakar, et al., 2024). Among these endurance training methods, interval training is the most popular and yields more significant improvements compared to other methods (Busyairi & Ray, 2018).

Interval training is a form of exercise that includes rest periods between each exercise set (Dhuha, Yogaswara, Abubakar, et al., 2024; Susila, 2021). Interval training has been shown to improve endurance more significantly than continuous training. Interval training is so popular that many coaches use it; however, the intensity, volume, and rest periods are often not tailored to the athletes' abilities (Gervasi et al., 2020; Harper et al., 2021; Osiński & Kantanista, 2017). Interval training can improve endurance and speed, but coaches must pay attention to the intensity and volume of the training to ensure they align with the desired training goals (Abdiliah et al., 2022; Figueiredo et al., 2020; Imai et al., 2018; Pani et al., 2021).

Training intensity is a measure of training load; a well-structured training program must include an intensity component (Dhuha et al., 2020). Training intensity must align with training periodization so that peak performance can be achieved, as one of the keys to a successful training program is the accuracy in determining peak performance (Mérida et al., 2023; Ouergui et al., 2022; Reis et al., 2024). The intensity used in interval training is 85 to 95% of maximum heart rate (MacInnis & Gibala, 2017). Interval training is conducted to acclimate athletes to high-intensity exercise, thereby simulating competition intensity, particularly in timed sports (Dhuha, Yogaswara, Hajar, et al., 2024).

High intensity in interval training helps the body adapt to high-intensity exercise because, during a match, the intensity remains high—especially when the match is closely contested, such as in a back-and-forth battle for points (Hardinata et al., 2023; Suryadi, Suganda, et al., 2023; Suryadi, Yanti, et al., 2023). However, the effectiveness of interval training is not determined by intensity alone; the duration of rest periods is a key factor in the success of an interval training program (Ardian et al., 2024; Saniah et al., 2024; Supriatna et al., 2023). Interval training combines work and rest in a measured ratio so that lactic acid does not accumulate to excessively high levels (Brastangkara & Jatmiko, 2019).

Previous research comparing 1:2 and 1:3 interval training ratios found that 1:2 interval training resulted in a more significant improvement (Ulum &

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Yunus, 2020). A comparison of 1:1 and 1:2 interval training ratios indicates that 1:1 interval training yields a more significant improvement (Adiputra, 2013; Budi & Sugiharto, 2015). Previous research indicates that in interval training, the work-to-rest ratio varies between 1:1 and 1:3; however, shorter rest periods result in a more significant increase in VO_2 max. The work-to-rest ratio is a key component of interval training; carefully measured rest periods aid athletes in the recovery process, and adequate rest duration helps reduce the buildup of lactic acid caused by high-intensity exercise and excessively short rest periods.

From a physiological perspective, interval training can increase white muscle fibers—that is, fast-twitch muscle fibers. High-intensity training places a heavier workload on the heart, thereby increasing oxygen consumption and boosting metabolism (Susila, 2021). Interval training not only improves endurance but can also increase speed, depending on the volume and intensity used. Interval training is divided into several types, namely short-distance, medium-distance, and long-distance intervals (Damanik et al., 2024). In interval training, the difference in training distance will affect the desired training effect; short-distance interval training primarily focuses on speed, while long-distance interval training primarily focuses on endurance.

Errors often occur in the design of exercise programs, such as misaligned goals, a lack of variety, and the inability to measure the effectiveness of the program (Alilah et al., 2022). A well-designed training program must include the training components of volume and intensity to specify the number of repetitions and the training load (Matjan, 2009). Intensity in endurance training begins with measuring maximum oxygen uptake using the multi-fitness test and the Balkes test, which are then broken down into the intensity percentages to be used, based on heart rate (Amrullah et al., 2025). Coaches with adequate sports science equipment can measure training intensity using a heart rate monitor; training intensity can also be measured as a percentage of maximum VO_2 max or as a percentage of the maximum load that can be lifted. When designing an interval training program, one must not only consider volume and intensity but also the ratio of work duration to rest duration. Previous research indicates that the work-to-rest ratio in interval training ranges from 1:1 to 1:3 (Shandy, 2025; Ulum & Yunus, 2020). This work-to-rest ratio serves as a guideline for designing interval training programs.

A gap in this study is that previous research has not thoroughly explained the intensity and volume used in work-to-rest ratios ranging from 1:1 to 1:3 in interval training. A limitation of previous studies is that many compared the significance of improvements in endurance, such as Budi & Sugiharto, (2015); Dhuha, Yogaswara, Hajar, et al., (2024); Shandy, (2025); Ulum & Yunus, (2020) exercise interval, continuous, and fartlek training; however, these interval studies did not specify the volume, intensity, and work-to-rest ratio used. The

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current finding of this study is that interval training with the shortest work-to-rest ratio—namely 1:1—can be completed by athletes with a 100% target achievement rate; therefore, athletes must be given an excessive training load, which aligns with the training principle of overload. Overload must be applied so that athletes adapt to the excessive load, thereby stimulating the body to adapt to the new training load. Overload can be applied by increasing intensity and volume or by shortening rest periods. The researchers aim to determine whether athletes can perform interval training with rest periods shorter than the work periods, thereby assessing the level of training achievement when interval training is conducted at a 1:3/4 ratio.

Setting training intensity too high and rest periods too short results in athletes being unable to complete the prescribed training program (Suryadi, Suganda, et al., 2023; Suryadi, Yanti, et al., 2023). When designing a training program, it should be individualized and specific; that is, each athlete's program should differ according to their individual abilities, and the training should be tailored specifically to the goals to be achieved. Errors in designing training programs—such as improper determination of intensity and rest periods—can lead to overtraining (Parman et al., 2025). There are various cases of inappropriate training program design, such as: young athletes sustaining injuries due to training loads that are inappropriate for their age; coaches prescribing the same training programs they used when they were athletes themselves; and prescribing high training intensity and volume.

Previous research indicates that the ratio of exercise to rest duration during interval training varies from 1:1 to 1:3 (Jam'anor & Nugroho, 2025; Shandy, 2025). Meanwhile, interval training designed to improve speed and power typically involves longer rest periods, with ratios ranging from 1:8 to 1:12. The accuracy in determining the ratio of exercise duration to rest time during interval training will influence the results and the athlete's success in completing their training program. Therefore, when designing a training program, a coach must ensure synchronization between the training objectives and the application of training loads, such as exercise intensity. Balancing intensity, volume, and rest time is crucial because it affects the program's objectives, the level of achievement, and helps prevent athletes from overtraining and injury.

The novelty of this study lies in the analysis of the performance levels achieved in a 400-meter interval training program consisting of 15 repetitions at 100% of VO_2 max, with a work-to-rest ratio of 1:3/4. The rationale for prescribing 15 repetitions of the 400-meter interval training was based on a preliminary study in which a 1:1 work-to-rest ratio with 15 repetitions resulted in all athletes successfully completing 100% of the training target; therefore, the researchers maintained 15 repetitions but shortened the rest duration. The work-to-rest ratio used in this study represents a novelty, as previous research

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indicated that the work-to-rest ratio in interval training ranges from 1:1 to 1:3 (Jam'anor & Nugroho, 2025). Interval training was conducted at an intensity of 85 to 95% of maximum heart rate (Hadiono et al., 2024).

Interval training based on maximum heart rate has the drawback of requiring expensive technology, such as a smartwatch and a heart rate monitor. Previous studies also did not specify the exact intensity and volume levels used for interval training with ratios ranging from 1:1 to 1:3 (Budi & Sugiharto, 2015; Ulum & Yunus, 2020). Therefore, this study aims to provide more specific information for designing a 15 x 400-meter interval training program at 100% of VO_2 max with a rest ratio of 1:3 or 1:4. This study also highlights an interval training method with shorter rest periods—specifically a 1:3/4 ratio—compared to previous interval training theories, which used ratios ranging from 1:1 to 1:3.

The objective of this study is to determine the effectiveness of a 1:3/4 interval training program consisting of 15 × 400-meter sessions at 100% of VO_2 max. The study aims to assess whether a 1:3/4 work-to-rest ratio is too strenuous, too light, or appropriate for athletes, thereby providing new scientific insights for developing measurable training programs designed to improve athletes' endurance. The contribution of this study is to serve as a reference for coaches in conducting interval training, particularly regarding rest duration, repetitions, and training intensity. This study can serve as a guide for coaches in designing measurable training programs tailored to each athlete's individual capabilities. Interval training with a 1:3/4 ratio is worthy of study because it offers a novel training method. Physiologically, short rest periods during training cause the body to undergo intense physiological adaptations to maintain performance through adjustments to the energy and cardiovascular systems; furthermore, short rest periods help the body recover more quickly when intensity is lower.

METHOD

Participants

This study was conducted at the Jatidiri Sports Complex in Semarang City on January 6 and 13, 2026. The subjects of this study were athletes from the Central Java Student Sports Education and Training Center (SSETC). The study population consisted of 10 athletes. The sampling technique used was purposive sampling, with the criteria being athletes who were in good health and not currently injured; as a result, a sample of 9 athletes was obtained. This was a small-scale study due to research limitations. The closer the sample size is to the population, the smaller the chance of generalization; conversely, the further the sample size is from the population, the higher the error in generalizing to the population. Therefore, the sample must be representative of the population (Santoso et al., 2023).

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Research Design

The research design of this study is a descriptive program evaluation study aimed at assessing the effectiveness of the exercise program administered. This research design was chosen because one of the principles of exercise is the principle of overload—that is, increasing the training load. In this study, increasing the training load involved shortening the rest duration between repetitions in interval training; since all athletes were able to complete the program with a 1:1 work-to-rest ratio, the training load had to be increased.

The research instrument used in this study is the Balke test to measure VO_2 max—a 15-minute running test to determine maximum oxygen uptake. This instrument is valid and reliable for measuring endurance, with a validity coefficient of 0.90 (p=0.003) (Fitriady, 2018). The data collection method involved performing 15 sets of 400-meter interval training at 100% of VO2Max capacity, with a work-to-rest ratio of 1:3 or 1:4. Data collection procedure: Each athlete performed 15 x 400-meter interval training with varying target times and rest intervals according to their individual goals, and records were taken for each set to evaluate the effectiveness of the training program.

Data Analysis

The data analysis involved measuring the level of achievement in a 15 x 400-meter interval training session with a work-to-rest ratio of 1:3/4, using the formula: number of repetitions completed according to the target ÷ 15 repetitions × 100%. This yields the percentage of achievement for the prescribed training program. The calculation results were described to compare each athlete's target time with the results of each repetition, determining whether each repetition met the target or did not. The results of each repetition were recorded and converted to percentages to determine the achievement rate for each athlete; the data analysis presented the maximum, minimum, and average values. The operational definition of an athlete's achievement rate is considered 100% if the athlete is able to complete the target of 15 repetitions of the 1:3/4 interval training; the achievement rate will be adjusted according to the athlete's ability to meet the training target. The formula used to calculate the achievement rate is: number of repetitions within the target : 15 repetitions × 100%, which yields the achievement rate.

FINDINGS AND DISCUSSIONS

Findings

The results of this study, following the Balke test and the collection of interval training data—conducted with 15 repetitions, 100% intensity, and a work-to-rest ratio of 1:3/4—are as follows.

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Table 1. Balke test results, average time per 400 meters, and rest duration

Name	Results (Meters)	100%/400M	Rest
1	3650	00:01:39	00:01:14
2	3420	00:01:45	00:01:19
3	3375	00:01:47	00:01:20
4	3375	00:01:47	00:01:20
5	3200	00:01:52	00:01:24
6	3300	00:01:49	00:01:22
7	3250	00:01:51	00:01:23
8	3240	00:01:51	00:01:23
9	3120	00:01:55	00:01:27
Average	3326	00:01:48	00:01:21

Based on initial data collected using the Balke test to create a training program, the average Balke test result was 3,326 meters, with a maximum of 3,650 meters and a minimum of 3,120 meters. Based on VO2Max data collection, the 15 x 400-meter interval training program had an average time of 1 minute 48 seconds, with the fastest time being 1 minute 39 seconds and the slowest 1 minute 48 seconds. Data collection for the interval training with a work-to-rest ratio of 1:3/4 yielded the following results:

NAMA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	%
1	00:01:26	00:01:30	00:01:33	00:01:33	00:01:38	00:01:36	00:01:31	00:01:33	00:01:32	00:01:34	00:01:32	00:01:30	00:01:29	00:01:29	00:01:27	100%
2	00:01:43	00:01:56	00:01:46	00:01:44	00:01:46	00:01:46	00:01:44	00:01:44	00:01:45	00:01:44	00:01:36	00:01:36	00:01:34	00:01:34	00:01:32	87%
3	00:01:43	00:01:56	00:01:46	00:01:44	00:01:46	00:01:46	00:01:44	00:01:44	00:01:45	00:01:44	00:01:40	00:01:40	00:01:39	00:01:37	00:01:35	100%
4	00:01:43	00:01:56	00:01:46	00:01:44	00:01:46	00:01:46	00:01:44	00:01:44	00:01:45	00:01:44	00:01:44	00:01:44	00:01:43	00:01:43	00:01:40	100%
5	00:01:54	00:01:46	00:01:46	00:01:48	00:01:46	00:01:46	00:01:48	00:01:46	00:01:42	00:01:36	00:01:46	00:01:46	00:01:42	00:01:39	00:01:30	100%
6	00:01:54	00:01:46	00:01:46	00:01:48	00:01:46	00:01:46	00:01:48	00:01:46	00:01:40	00:01:43	00:01:48	00:01:47	00:01:46	00:01:40	00:01:30	100%
7	00:01:54	00:01:46	00:01:46	00:01:48	00:01:46	00:01:46	00:01:48	00:01:46	00:01:42	00:01:43	00:01:40	00:01:37	00:01:36	00:01:36	00:01:20	100%
8	00:01:54	00:01:46	00:01:46	00:01:48	00:01:46	00:01:46	00:01:48	00:01:46	00:01:42	00:01:45	00:01:48	00:01:48	00:01:48	00:01:47	00:01:46	100%
9	00:01:55	00:01:53	00:01:54	00:01:55	00:01:54	00:01:55	00:01:51	00:01:48	00:01:46	00:01:52	00:01:55	00:01:50	00:01:47	00:01:42	00:01:34	100%
Mean	**00:01:47**	**00:01:48**	**00:01:45**	**00:01:46**	**00:01:46**	**00:01:46**	**00:01:45**	**00:01:44**	**00:01:42**	**00:01:43**	**00:01:43**	**00:01:42**	**00:01:40**	**00:01:39**	**00:01:33**	**99%**

Figure 1. Percentage of interval training completion

Based on the data collected from the interval training with a 1:3/4 ratio, 8 athletes achieved 100% completion of the training program, while 1 athlete achieved 87% completion—meaning 2 repetitions fell short of the training target. The average completion rate for the training program was 99%. Based on the interval training data collected with a work-to-rest ratio of 1:3/4, the following graph shows the recorded times for each repetition:

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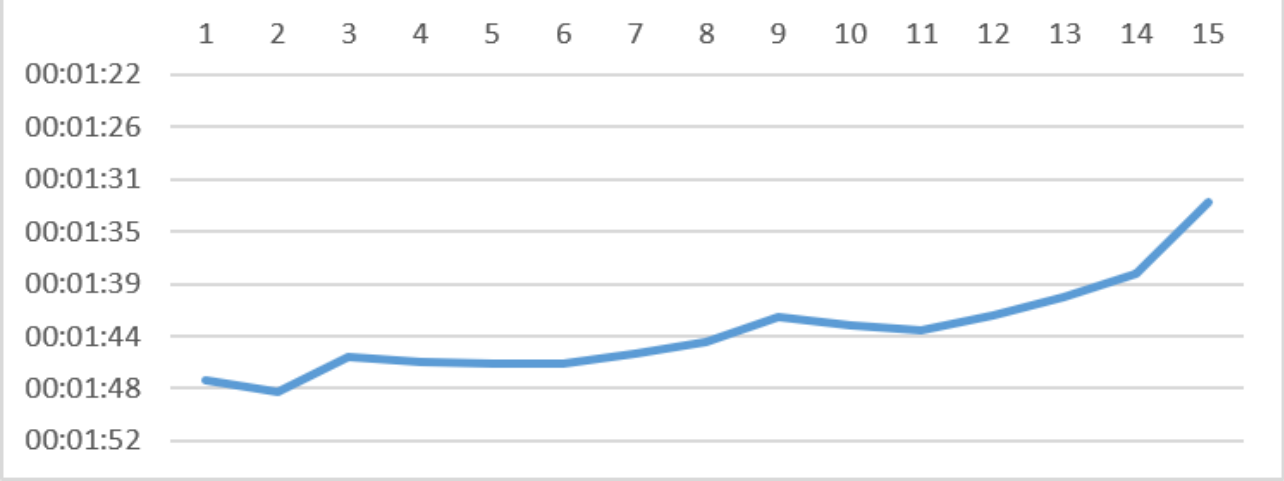

Figure 2. Mean running time across 15 repetitions.

Based on the training graph, at the beginning of the session, the average times were within the target range but were not particularly fast. This may have occurred because the athletes were still adapting to the given targets and conserving energy to complete all 15 repetitions. From repetitions 11 through 15, there was a noticeable increase in running time, indicating that there was no decline in the athletes' performance; in fact, the times in the final repetitions demonstrated the athletes' good endurance.

The conclusion from the results of this study is that 400-meter interval training with a work-to-rest ratio of 1:3/4 can be performed by athletes with an average achievement rate of 99%, indicating that this training is neither too easy nor too difficult for athletes to perform. This training can be performed over a 400-meter distance, with a repetition volume of up to twice the Balke test distance. However, when creating a training program, one must consider the athletes' condition and training experience, as this program was applied to athletes from Central Java who already have sufficient training experience.

Discussion

The results of the study indicate that athletes who undergo a 15 × 400-meter interval training program at 100% intensity with a work-to-rest ratio of 1:3/4 can serve as a reference for interval training programs. Of the 9 PPLOP Central Java basketball athletes who participated in the program, 8 achieved a training completion rate of 100%, while 1 athlete achieved 87%, with an overall average completion rate of 99%. These findings indicate that a 1:3/4 work-to-rest ratio provides sufficient recovery time to maintain performance during 15 repetitions of 400-meter interval training without experiencing a decline in performance caused by excessively short rest periods. One athlete had an

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achievement rate of 87%, meaning two repetitions—the 5th and 6th—did not meet the specified target time. For the 400-meter run, the athlete's target time was 1 minute 45 seconds, but the athlete recorded a time of 1 minute 46 seconds—a 1-second delay. A 1-second delay is still within the tolerance range; this can occur because the athlete ran too wide, increasing the distance; delays in timing; and fluctuations in the athlete's running speed due to obstacles on the track. "These findings indicate that a 1:¾ ratio provides sufficient recovery time to maintain performance over 15 repetitions."

The results of the study show that a 15 x 400-meter interval training regimen with a 1:3/4 ratio provides a moderate training load—not too strenuous—as evidenced by an average achievement rate of 99%. This 1:3/4 interval training regimen offers a new training method with shorter rest periods compared to the previous 1:1 ratio. Differences in target times among athletes are due to variations in maximum oxygen uptake, fitness levels, and training adaptation, so each athlete's target time will differ. The basis for these differences is the principle of individual and specific training (Haïdara et al., 2023; Hardinata et al., 2024; Purnomo et al., 2023). This means that each athlete has different capabilities, so their training programs and time targets also differ. Average times improved with each repetition, indicating that the training program provided an adequate training load for the athletes, as the average achievement rate reached 99%. This training program aligns with previous research stating that training programs that are too intense or too light do not lead to improvements in fitness (Parman et al., 2025).

The physiological mechanisms at work during interval training with short rest periods improve endurance by triggering cellular stress; the heart works harder to pump oxygen, and muscles become more efficient at producing energy and clearing metabolic waste (MacInnis & Gibala, 2017). Active rest during interval training helps accelerate the clearance of lactate produced by high-intensity exercise, thereby speeding up recovery for the next set (Nalbandian et al., 2017). Interval training enhances the body's ability to rapidly restore heart rate through cardiovascular system adaptation (Stöggl & Björklund, 2017). Based on previous research on the physiological mechanisms of interval training with short rest periods, it can be concluded that athletes with a high VO_2 max will have an improved oxygen supply to their muscles, which delays lactate formation during high-intensity exercise. Consequently, athletes can maintain their performance even when given short rest periods during high-intensity training.

The training program in this study focused on improving endurance and VO_2 max through high-intensity interval training (Hardinata et al., 2023; Lau et al., 2020; Nobari et al., 2021; Yudi et al., 2024). The total training volume administered was nearly double the athletes' Balke test results, while the 400-

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meter distance falls into the category of moderate-distance interval training. Training at 100% intensity is classified as very high-intensity exercise (Lopez et al., 2023). Unlike resistance training, where 100% intensity typically allows for only one repetition, interval training still enables athletes to perform more repetitions due to the use of shorter distances. Previous studies have not detailed the intensity and training volume that athletes can tolerate in light, moderate, or heavy training categories (Ulum & Yunus, 2020). Therefore, the results of this study can serve as a reference for coaches in designing interval training programs. Athletes were shown to be capable of performing training at an intensity equivalent to 100% of their endurance capacity, but with shorter distances and a training volume approaching twice the test distance. Light training is performed at an intensity below 70%, moderate training at an intensity of 70–85%, and heavy training at an intensity of 85–100% (Dhuha et al., 2025).

The relationship between training intensity and volume is a key factor in achieving training goals. In speed endurance training, for example, workouts are performed at high intensity but with low to moderate volume (Bangsbo et al., 2025). Intensity itself refers to the magnitude of the training load expressed as a percentage, whether in terms of running time or weight in kilograms during a workout (Hadi & Yudhistira, 2024). Coaches need to adjust intensity, volume, and rest periods so that training yields optimal physiological adaptations. The balance between training load and recovery time is also a crucial factor in interval training. Setting the intensity and volume too high with short rest periods can make the workout too strenuous for athletes. Conversely, training with low intensity and excessively long rest periods will not provide an optimal training stimulus.

The effects of training will be achieved when the load and rest periods are in the right proportion so that the body gets sufficient recovery (Pel'menev & Vdovichenko, 2025). Coaches must pay attention to the timing of rest periods so that athletes can return to training at their maximum capacity (Amansyah & Daulay, 2019). When designing a well-structured training program, coaches need to consider key training components such as intensity, volume, and rest duration (Dhuha, Yogaswara, Hajar, et al., 2024). Endurance training typically involves light to moderate intensity with high volume. Conversely, speed training uses high intensity, low volume, and longer recovery times. Therefore, the ratio of work time to rest time in interval training will significantly influence the achievement of training goals.

The importance of regulating the work-to-rest ratio is also evident from its effect on lactate production. Excessively high intensity combined with short rest periods increases lactate buildup, making it difficult for athletes to complete the workout. Conversely, workouts with low intensity and excessively long rest

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periods tend not to produce significant physiological changes. The 15:15 interval method at 120% of maximum aerobic speed effectively improves endurance (Dai & Xie, 2023). This previous study showed that athletes are able to adapt to high-intensity training when the duration or distance of the workout is kept shorter. Based on their characteristics, interval training is categorized into intensive and extensive intervals. Intensive interval training uses short distances at high intensity, while extensive interval training uses longer distances at moderate intensity (Perdana, 2024). Coaches must tailor the type of interval training to the training objectives to prevent overtraining in athletes.

The findings of this study also correct previous research that stated the work-to-rest ratio in interval training ranges from 1:1 to 1:3 (Shandy, 2025; Utomo & Sartono, 2025). Previous research has shown that a 1:1 ratio results in a greater increase in VO_2 max compared to 1:2 and 1:3 ratios. However, rest periods that are too short during high-intensity training can increase lactate levels and affect performance consistency across repetitions (Rogers et al., 2024). Rest duration in interval training is known to affect performance, physiological adaptation, and athletes' fatigue levels, or Rate of Perceived Exertion (RPE). Short rest periods can indeed stimulate an increase in VO_2 max because the body works harder, but the duration must still be adjusted according to the athlete's ability.

Based on distance, interval training is divided into short distances (under 500 meters), medium distances (500–1,500 meters), and long distances (over 1,500 meters) (Parmar et al., 2021). The determination of training distance must be adjusted according to training periodization and competition requirements. The longer the training distance, the more the training focus shifts toward improving endurance, whereas shorter distances are more oriented toward improving speed. In this study, the average completion time athletes must achieve is 1 minute 48 seconds; thus, the dominant energy systems utilized are fast and slow glycolysis, with anaerobic energy contributing 50–80% and aerobic energy 20–50% (Hadi & Yudhistira, 2024). This exercise involves a combination of aerobic and anaerobic energy systems, although the anaerobic system is primarily dominant.

Aerobic energy system-based interval training is performed at moderate intensity and high volume, whereas anaerobic training uses high intensity with low volume (Stöggl & Sperlich, 2019). This study demonstrates that athletes can still perform high-intensity training with moderate volume even with relatively short rest periods. Overall, this study provides new findings that athletes are capable of performing interval training with a volume nearly double that of the 100% intensity test results. These findings can serve as a reference for coaches in designing interval training programs, as such programs tend to be feasible for the majority of the athletes studied.

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Limitations

This study confirms that the intensity, volume, and work-to-rest ratio must be adjusted according to the training goals—whether to improve endurance, speed endurance, or speed—and that, with the proper settings, high-intensity training with short rest periods can still be performed by athletes and provide optimal physiological adaptations. Limitations of this study include a small sample size, a study population limited to a single sport, the absence of a control group, and the failure to measure blood lactate levels and the Rate of Perceived Exertion (RPE).

CONCLUSION

The conclusion of this study is that a 15 × 400-meter interval training program at 100% VO_2 max intensity, with a work-to-rest ratio of 1:¾, can be completed by most athletes with an average completion rate of 99%. These findings suggest that this ratio has the potential to provide sufficient recovery to maintain performance during high-intensity interval training. Therefore, the 1:¾ ratio may be considered as an alternative when designing endurance training programs for athletes with similar characteristics. The implications of this study for coaches are that it serves as a reference for creating measurable interval training programs to improve endurance while avoiding overtraining caused by excessively heavy training loads. When conducting high-intensity interval training with short rest periods, coaches must pay attention to the athletes' physical condition and training history. Interval training with a 1:3/4 ratio can be implemented by first conducting a test to determine VO_2 max using the Balke test. Analyze the Balke test data to determine the average speed per 400 meters and set the rest duration to 3/4 of the running duration; the total number of repetitions in this interval training can be twice the distance of the Balke test.

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AUTHOR CONTRIBUTION STATEMENT

AAD was responsible for the manuscript, conception, and design of the study. SW and EK acquired the data, analyzed, and interpreted the data. MFF assisted in manuscript preparation and obtained funding.

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AI DISCLOSURE STATEMENT

No artificial intelligence (AI) tools were used in the preparation of this manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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