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The effect of interval training on athletic 100 meter running speed: a meta-analysis study

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Abstract: : This research on the effect of interval training on 100 meter running speed has been widely done in sports. Various researchers explain that interval training is very influential in increasing the speed of running 100 meters, but each study reports different results. This difference causes the need to conduct inclusive data analysis to provide comprehensive information about the importance of interval training to increase 100-meter running speed in athletic athletes. This method must be done by collecting data from research results indexed on Google Scholar by searching for research published in the range of 2010-2021. The search for the results of this study was carried out by entering two keywords, namely the first keyword "interval" AND "100 meter run" AND "journal" OR "journal" with the results found 224 articles and the second keyword is "interval" AND "100 meter sprint" with the results found 139 articles. Data on articles that already fit the study's inclusion and exclusion criteria were taken to determine the effect size (ES) and standard error (SE) values. The results of this study show the value of the RE estimate and FE model 11.243 junior high school criteria and the value of the RE estimate and FE model 9.786 athlete criteria which means that this interval training has a significant effect on the junior high school level and athletes who focus specifically on 100 meter running speed. This research is only limited to 100-meter sprints in junior high school students and athletes, it is recommended that future researchers examine other sports and other subjects.

Keywords: interval training; meta-analysis; sprint.

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INTRODUCTION

Sports activity is a physical activity that is carried out intensively and is very important for humans to do every day (Hidayat, 2010). Humans have different goals, some have plans to develop sports achievements, maintain physical health, and just for recreational activities. To achieve a sporting achievement requires effort and hard work in the form of a program that a coach, measurable and sustainable, has designed. Achievements can be achieved by doing hard work in practicing whose programs are planned, measured, and balanced. Physical components must meet factors to achieve high achievement by training strength, speed, coordination, power, muscle endurance, and balance (Nugroho, 2017).

Athletics is one of the sports currently in great demand by the people in Indonesia, athletics is the parent of all sports because athletics is the basic movement for other sports (Febrianti, 2013). Athletics has several movements, namely, fast walking, running, throwing, and jumping. The movements in athletics are basic movements of athletes comprehensively (Agari et al., 2019). The formation of clubs and extracurricular sports in Indonesia is a forum to make it easier for athletes to channel and hone talents of interest. This

athletic championship has several contested running numbers, such as running, fast walking, jumping, and throwing. Running numbers contested in each championship include short-distance, middle-distance, and long-distance running (Ambara, 2011).

There are three kinds of running numbers, namely, short distance running (sprint), middle-distance running (middle-distance running), and long-distance running (long-distance running). In addition to the three basic runs above, there are other running numbers, namely relay running, hurdle running, and steeple chase (Sapitri et al., 2011). Short distance running (sprint) is one of the running numbers in athletics that is very prestigious and in great demand because it is a running that starts from start to finish at maximum speed (Humairoh et al., 2021). This athletic branch's short distance running number (sprint) has several mileage running numbers ranging from 60 meters, 100 meters, 200 meters, 400 meters, and hurdles. Sprint must also be considered the energy system athletes use because they use energy supplies stored in themselves (Komariah, 2020). Sprint running also requires good acceleration, efficient running types, and, most importantly, speed (Putu et al., 2013).

This speed has a huge role in achieving the results of sports achievements in an athlete, speed has an important role and is also needed in every sport, there are several terms regarding speed in sports. Speed is the ability of an athlete's organism to make movements that can run in the shortest possible time to achieve the desired results (Damayanti, et al., 2021). In the short distance running number (sprint), especially the 100-meter running number, speed plays a very important role to reach the finish line in a very fast time, the key to running 100 meters lies in running speed (Sinurat, 2016). Increasing speed in short distance running (sprint) that is maximized needs to be done consistently. One of the exercises that can be done to affect the speed of short distance running (sprint) is to use interval training.

Training must have a program that has been carefully and rationally arranged in the training program. In making an exercise program, it must also be designed and organized in order to get maximum athlete performance results. One of the exercises that have an important role in improving performance in athletes is physical exercise because physical exercise speed is very influential in increasing running speed in order to cover the distance in the shortest possible time (Herfiantoro, 2019). To increase the maximum sprint, it is necessary to practice consistently. One of the exercises that can be done to influence short distance running speed (sprint) is to use interval training.

This interval training has the aim of increasing strength in muscles, especially leg muscles, because interval training has systematic exercises to improve running ability and achieve goals such as physical condition, strength, and achievement, which are very important in athletics, especially in 100 meter short distance running (Burstiando, 2015). The definition of interval training is a system of intervals in the form of rest periods. There are several factors that must be considered in this interval training, namely intensity or training load, length of training, repetition or repetition of training, and internal recovery (rest period between exercises). Training load can be translated into tempo, speed, and weight. The length of the exercise

can be seen from the distance or time. Repetition can be seen from the repetition of exercises that must be done, and the rest period is the period of stopping doing exercise or resting between these exercises. There are two types of interval training: slow interval training and fast interval training. Slow interval training is training with a long distance, including a training duration of 60 seconds-3 minutes, training intensity of 10%-70% of maximum, repetition of running 10-20 times, and rest of 3-5 minutes. While fast interval training is training with a closer distance, including a training duration of 5-30 minutes, training intensity of 85%-90% of the maximum, repetition of running 20-25 times, and rest of 30-90 seconds (Arfa, 2015).

High-intensity interval training is training to improve speed, power, and technical movements. The volume of the training load is inversely proportional to the intensity of the training load. Increasing the training load can be achieved by increasing the volume and power, shortening the recovery time, and frequency and tempo. It is also possible to increase the training load, increasing all the characteristics of the training load. This training method is carried out with a relatively short amount of load, with intensity ranging from 10%-90% high based on the length of loading between 30-60 seconds with no full rest. Low-intensity interval training is commonly used to improve endurance. Training techniques at the beginning and training tactics. This training method is characterized by medium intensity, free load volume based on many repetitions, and accompanied by not full or perfect rest. Not full rest means that the exercise must be restarted when the heart rate is close to 120-140 times per minute (Parwata, 2022).

This interval training is suitable for optimizing speed in the 100 meter run, because interval training is very influential for muscle strength, especially in the leg muscles, and increases the power of running speed (Suhdy, 2018). Because power in the leg muscles is the key to running 100 meters to increase running speed and can cover the running distance in the shortest possible time. Interval training is done repeatedly and interspersed with predetermined rest periods (Gaos Sungkawa et al., 2020). Meanwhile, according to (Komariah, 2020), interval training is the provision of training loads on the body with a period that is as short as possible with regularity and repetition interspersed with intervals. Based on several opinions about interval training, this interval training is very influential for running speed, especially running 100 meters, by increasing leg muscle power training.

Studies examining interval training to improve speed in short-distance running (sprint) have been conducted in many sports. Various studies say interval training plays an important role in increasing short-distance running speed (sprint), but each study provides different results. According to previous researchers, interval training is very important to be included in the training program (Komariah, 2020). Researchers suggested that interval training significantly increased running speed at SMP Negeri 44 Palembang (Giartama, 2018). Interval training at SMP Budhi Luhur Pekanbaru City is also very influential in increasing sprint running speed (Hajar et al., 2016). The effect of interval training provides very positive results for the development of muscle endurance in the legs and stamina in an athlete, the form of interval training can be in

the form of running (interval running) or swimming (interval swimming) and can also be applied with weight training, circuit training and so on (Arfa, 2015).

The purpose of this study is to analyze the results that have existed before to find out how important the effect of interval training is on the speed of running 100 meters in a runner. With the explanation that has been explained above, research will be conducted on the effect of interval training on athletic short distance running speed (sprint) through a meta-analysis study by analyzing various studies that have been conducted but have not been tested further to provide comprehensive results.

METHOD

This study uses the meta-analysis method in analyzing data. Meta-analysis is a series of studies used to review and summarize data and analyze research that has been done or research that has been done (Kriswanto et al., 2021). The name meta-analysis was coined by Glass in 1976, referring to the philosophy that arises in every collection of scientific research data evidence, which is currently known as a set of statistical procedures that are widely used in the fields of science and social science that objectively assimilate and measure the effects of each empirical study or study that has been conducted and eliminate bias in a study.

The sources of this research data were obtained from scientific literature sources in the form of research articles that have been published in national journals. Data acquisition is made online through google scholar. The article search was carried out by visiting the source's website, namely https://scholar.google.com. The search by entering the first keyword "interval" AND "100 meter sprint" AND "journal" OR "journal" found 224 articles and the second keyword "interval" AND "100 meter sprint" found 139 articles accessed on May 10, 2021. The determination of this sample was carried out using purposive random, which is a sampling technique using specific criteria. The sample selection criteria use two criteria, namely, inclusion criteria and exclusion criteria. The inclusion criteria and data exclusion criteria used in this study are:

Inclusion Criteria:

1. Research using the interval training method.
2. Articles published in national scientific journals that have been published and not repository articles or proceedings.
3. The articles taken are full-text articles that can be accessed.
4. Articles sourced from google scholar.
5. The articles taken use a quantitative research structure.
6. The research design uses a pseudo-experiment.
7. The subjects used in this study only used junior high school students' subjects.
8. The research was conducted in Indonesia.

Exclusion Criteria:

1. Studies with different operational definitions.
2. Research that is not available in full text.

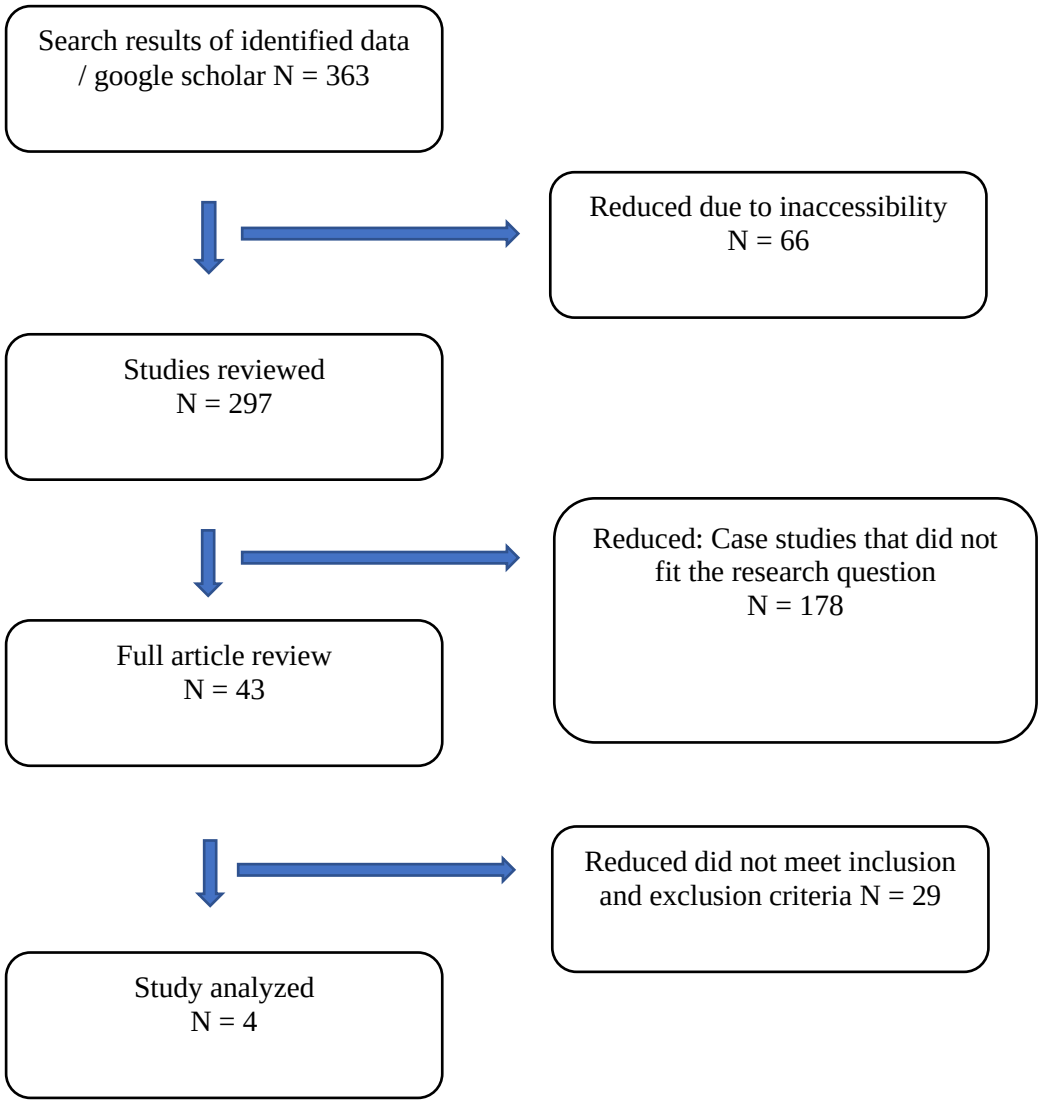

Figure 1. Flowchart for identifying eligible case study data for meta-analysis

After searching for data from various sources, the next stage is data analysis which will be carried out through (1) identification of research variables, data is entered into the table according to the variable column, (2) identification of the r value in each article analyzed. If the reported research results only contain F or t values, then they are transformed into r values, using the equation:

1. $F = t^2$
2. $t = \sqrt{F}$
3. $r = \frac{t}{\sqrt{t^2+N-2}}$

(3) transform the r value to the z distribution, which is the effect size of each study, then calculate the variance, (4) calculate the Standard error of z, and (5) calculate the summary effect of the entire study (Nuraini & Muhlis, 2021). The summary effect calculation was carried out using meta-analysis with the help of Jeffreys's Amazing Statistics Program (JASP) software version 0.16.0.0.

RESULTS AND DISCUSSION

The next stage was a meta-analysis study that used research data that had passed the selection stage. A total of 359 data did not meet the inclusion or exclusion criteria to be analyzed from 363 data obtained. A total of 4 studies that were ready to be explored were obtained from the database source Google Scholar. The studies to be analyzed are presented in Table 1 below.

Table 1. Data Study to be conducted Meta-Analysis Study on Junior High School Students

Name	Sampel Characteristics	N	t-count	Types of exercise	R	ES	SE
Abdul, R., & Sugiarto (2015).	Junior High School of Jenawi Karanganyar District	20	4.76	Interval Anaerob	0.653	7.821	0.174
Siti, H., Ramadi., & Ardiah, J. (2016).	Budhi Luhur Junior High School Pekanbaru	36	8.74	Interval Training	0.831	11.94	0.174
Giartama. (2018).	State Junior High School 44 Palembang	60	11.66	ABC running training	0.837	12.11	0.132
Septi, C. P., & Yogie, I. P. (2021).	SMP-IT AL Barokah Pandeglang	15	12.622	Circuit training	0.961	19.65	0.288

1. Heterogeneity Test

Table 1. Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	37.599	1	< .001
Test of Residual Heterogeneity	774.038	3	< .001

Note. p -values are approximate.
Note. The model was estimated using Restricted ML method.

From the calculation results in Table 2, the four effect sizes of the studies analyzed above show heterogeneity results (Q = 774.038, p <.001). Thus, the random effect model is more suitable for determining the average effect size of the four studies analyzed above. The analysis results also indicate the possibility of investigating moderator variables that affect the relationship between interval training and 100-meter running speed.

Table 2. Coefficients

					95% Confidence Interval	
	Estimate	**Standard Error**	**z**	**p**	**Lower**	**Upper**
intercept	13.334	2.175	6.132	< .001	9.072	17.596

Note. Wald test.

The results of the analysis above show an estimated value of 13,334 and don't show negative results, but using a random effect model shows that there is a significant positive correlation between interval training and 100 meter running speed (z = 6.132; p < 0.001; 95% CI [9.072; 17.596].). There is an effect of interval training on 100 meter running speed, including in the high category.

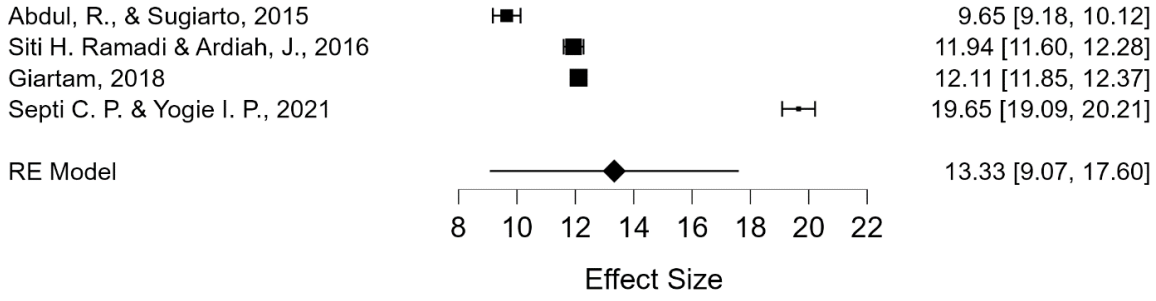

Figure 2. Forest Plot of Effect Size Distribution

The Forest plot presents data on the distribution of effect size. Based on the forest plot above, it can be seen that the effect size of the studies analyzed with various variations is between 9.65 and 19.65.

2. Publication Bias Analysis

A publication bias analysis was conducted to determine the presence or absence of bias in each of the studies analyzed.

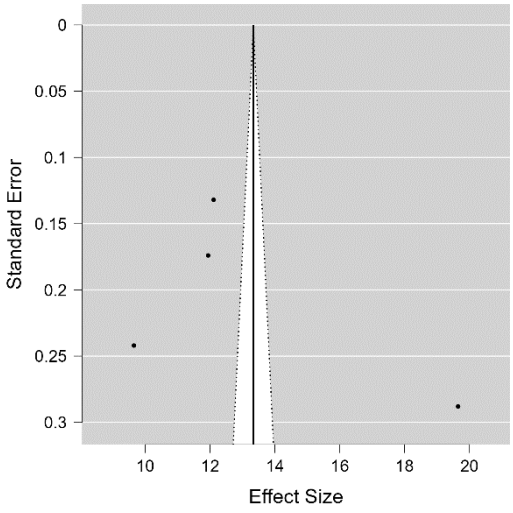

Figure 3. Funnel Plot

From the results of the funnel plot in Figure 3, it is very difficult to conclude whether the funnel plot above is symmetrical or not, so Egger's test must be used to test whether the funnel plot is symmetrical or not.

Table 4. Regression test for Funnel plot asymmetry ("Egger's test")

	z	P
sei	0.989	0.323

Interpretation: p > 0.32 confirms that the funnel plot above is symmetrical. It can be concluded that there is no problem with the publication bias of the meta-analysis study.

Tabel 5. File Drawer Analysis

	Fail-safe N	Target Significance	Observed Significance
Rosenthal	26636.000	0.050	< .001

Interpretation: Since K = 3, 5K + 10 = 5(3) + 10 = 25. The fail-safe N value obtained is 26636,000, with a target significance of 0.05 and p < 0.001. Since the fail-safe N value > 5K + 10, it can be concluded that there is no publication bias problem in the meta-analysis study.

This interval training is one of the methods that can be used to increase leg muscle speed and endurance in the 100 meter run. Based on the results of the analysis above, there is a positive and significant relationship between interval training with a random effect (rRE) value of 13.334. This value indicates that this variable has a high category relationship, where the more interval training is done, the more running speed increases.

The results of the publication bias analysis are complicated to explain in the funnel plot image, so egger's test and fail-safe N. Both of these analyses show no publication bias in the analyzed studies. This means that the data meta-analysis study conducted on the effect of interval training on 100-meter running speed can be accepted as data that is not vague and in accordance with current conditions.

Discussion

The findings of this study suggest that interval training can increase 100-meter running speed. An effect shows that interval training can be used to increase speed to achieve the best 100 meter running results. Interval training is done repeatedly and interspersed with a predetermined rest period (Gaos Sungkawa et al., 2020). This interval training must also be done with an existing program to get satisfactory results so that the power in the leg muscles can increase the speed of running 100 meters and take the best possible time. Sprint is a run that starts from the starting line to the finish line and is carried out at maximum speed (Winata, 2015). Sprint aims to achieve maximum speed results by pushing the body forward to reach the finish line or the specified distance with a record time as quickly as possible (Hajar et al., 2016).

Interval training is often referred to as training to increase endurance, but this 100 meter running number interval training is one of the exercises that can increase strength in the muscles, especially in the leg

muscles. A suitable exercise to maximize and stabilize running speed is interval training because running is a fast movement and involves the power to increase running speed (Wiswadewa et al., 2017). Interval training also has a significant effect on improving 100 meter running performance (Suhdy, 2018). Interval training is proven to increase leg muscle power. Based on several existing opinions, it can be concluded that interval training can increase leg muscle power so that it can increase running speed (Evitamala et al., 2019). Although the results of the funnel plot do not illustrate symmetrical results, the eger test and file drawer analysis show that this meta-analysis does not indicate publication bias.

According to the results of this study, interval training is very influential on leg muscle power, the information above can be used as a source of reference for the same researchers to conduct research on interval training in various sports, especially for increased power and speed so that, creating the latest research creative and innovative.

CONCLUSION

The study's results reported that the data presented above had positive results because interval training on 100-meter running speed overall increased or had a good effect on the results of running 100 meters to the maximum.

The findings of research reports on the effect of interval training exercises on increasing 100-meter running speed are minimal in number, so the challenge of future research is to investigate the impact of plyometric training on middle distance and relay running speed.

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