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LITERATURE REVIEW: THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING (HIIT) ON VO2MAX IN MALE ADOLESCENTS

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Abstract

In sports closely related to good endurance. to do sports, especially in sports that use more endurance. Achievement sports require athletes to have good endurance. The purpose of this study was to measure the impact of high intense interval training (HIIT) on VO2Max levels in adolescents men. This research method uses a literature review, by searching for articles from databases sourced from Google Scholar and then extracting them through inclusion using PICO. The results of this study indicate that HIIT has the ability to increase VO2Max in adolescent men. Based on an analysis of 12 articles, it was concluded that HIIT has a significant and effective impact on increasing VO2Max in adolescent men

Keywords: *High Intensity Interval Training (HIIT); VO2Max; Adolescent men.*

Abstrak

Dalam olahraga erat kaitannya dengan daya tahan tubuh yang baik. untuk melakukan olahraga terutama pada cabang olahraga yang menggunakan daya tahan yang lebih. Olahraga prestasi menuntut atlet untuk memiliki daya tahan tubuh yang baik. Tujuan dari penelitian ini merupakan untuk mengukur dampak dari high intensity interval training (HIIT) terhadap tingkat VO2Max pada remaja laki-laki. Metode penelitian ini menggunakan literature review, dimana pencarian artikel dilakukan melalui database yang bersumber dari Google Scholar. Kemudian, artikel-artikel tersebut disaring berdasarkan kriteria inklusi yang dijelaskan dengan menggunakan PICO. Hasil dari penelitian ini menunjukkan bahwa HIIT memiliki kemampuan untuk meningkatkan VO2Max pada remaja putra. Berdasarkan analisis terhadap 12 artikel, disimpulkan bahwa HIIT memiliki dampak yang signifikan dan efektif dalam meningkatkan VO2Max pada remaja putra.

Kata kunci: High intensity interval training (HIIT); VO2Max; Remaja Putra

1. Introduction

Sport plays a vital role in human daily life (Wibowo, 2020). It represents a structured form of physical activity that involves body movements with the primary purpose of enhancing an individual's health and physical fitness. Over time, sport has continued to develop and has evolved into the realm of achievement-oriented or competitive sport. Competitive sport refers to activities designed to attain specific performance outcomes (Riduwan et al., 2022). In competitive sporting environments that demand high levels of physical exertion, athletes require exceptional endurance. Endurance is one of the most dominant components of

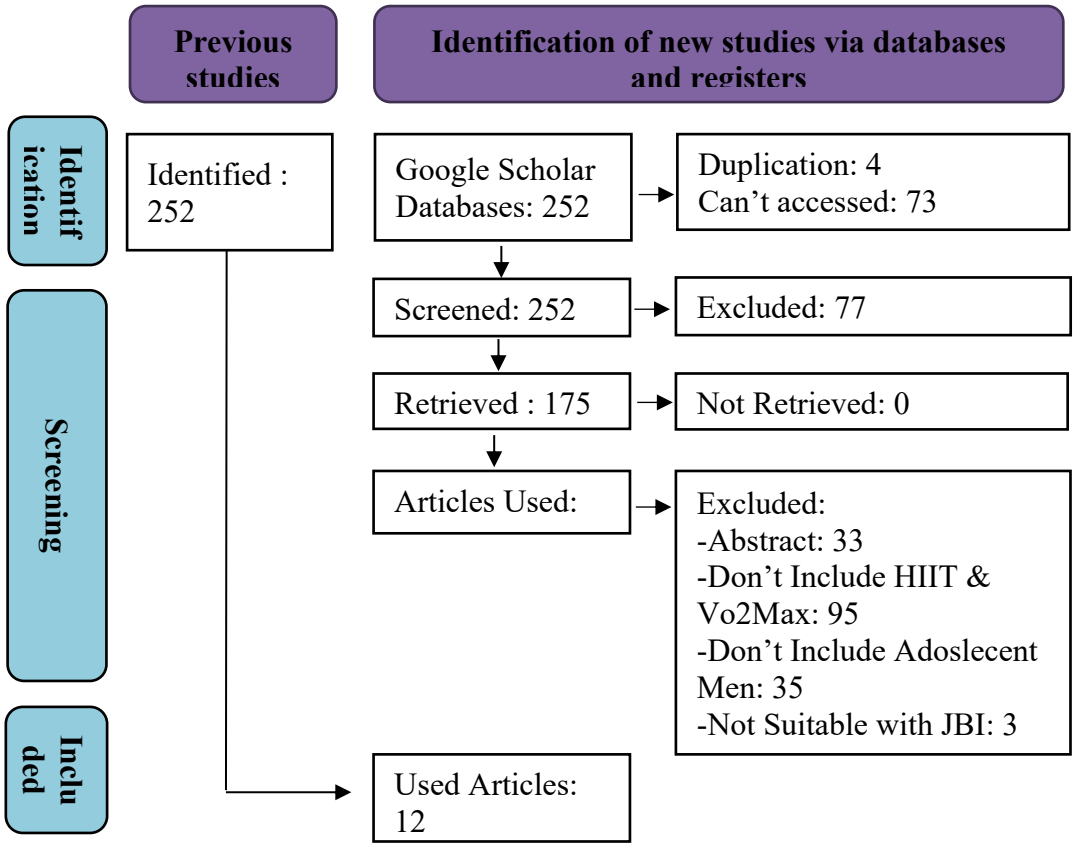
physical condition in sports characterized by intensive physical activity, such as soccer. (Indrayana & Yuliawan, 2019).

The method commonly used to measure an individual's cardiorespiratory endurance is the assessment of *VO2Max*. Individuals with superior cardiorespiratory endurance typically demonstrate higher *VO2Max* values, enabling them to engage in more demanding physical activities compared to those with lower VO_2Max levels (Waskito et al., 2017). During long-lasting and high-intensity physical activity, the body requires a greater supply of oxygen. The greater the amount of oxygen consumed by the body, the more efficient muscle performance becomes, resulting in reduced levels of fatigue (Astawan & Widhiyanti, 2023).

HIIT is a training method that combines high-intensity exercise with rest periods interspersed with moderate or low-intensity exercise (Nugraha & Berawi, 2017). Various forms of activity can be implemented, including walking, running, stair climbing, cycling, and swimming. According to Harsono (2015), the variations in HIIT training: (1) exercise duration, (2) training load, (3) number of repetitions, and (4) rest duration between repetitions. High-intensity intervals are typically performed for 5 seconds to 8 minutes at approximately 80% to 95% of maximum heart rate (HRmax), while recovery periods are conducted at around 50% to 70%. One of the advantages of HIIT lies in its ability to improve maximal oxygen uptake (VO_2Max) within a relatively short training duration, emphasizing recovery intervals as a critical component for supporting the enhancement of energy fitness capacity. HIIT can serve as an alternative for individuals who have limited time available for exercise. Therefore, HIIT is considered a suitable training option for improving endurance, particularly among adolescent athletes who are still in a phase of rapid growth and education. Based on previous research conducted by Radif et al. (2019) entitled *"The Effect of Interval Training on Maximum Oxygen Volume in Futsal Extracurricular Activities,"* it was found that interval training has a positive impact on improving an individual's VO_2Max.

2. Methods

This study employed a literature review method, which involves the analysis of several previously published research articles. Data collection was carried out using the Google Scholar database, with the following keywords used to identify relevant articles: *"HIIT" and "VO_2Max" and "male adolescents."* The range of publication years reviewed was limited to the past five years, from 2018 to 2022. The inclusion criteria used were: (1) male adolescents, (2) the application of HIIT, (3) the effects of HIIT on VO_2Max in male adolescents, and (4) experimental research design. Data extraction was performed using the PRISMA flowchart.



3. Result and Discussion

A. Result

This literature review was conducted to identify whether there is an effect of High-Intensity Interval Training (HIIT) on VO_2Max levels in male adolescents, using selected literature obtained through a systematic search process.

Table 1 Statistical Analysis of the Reviewed Articles

No	Authors & Year	Journals	Indexing	Research Method	Data Collection Method	Selection Method	Statistical Analysis
1	(Septiaji, Arif P, Muhammad Yusuf; Marzuki, 2021)	Spotify Jurnal	Garuda	Experimental Method	One-group pretest-posttest design	Total sampling	Paired Sampe T-Test

2	(Wibowo, 2020)	JOSSAE	Sinta	Experimental Method	Quasi Experimental	Total Sampling	Descriptive Statistics using SPSS
3	(Wirawan & Griadhi, 2020)	DiscoverSys	DOAJ	Experimental Method	Pre and Post Test Group Design	Total Sampling	SPSS application
4	(Windiastoni & Haritsah, 2019)	Jurnal Ilmu Kesehatan	Sinta	Experimental Method	Pre-test and post-test one group design with control group	Total Sampling	Kolmogorov –Smirnov Test, Paired Sample t-test, and SPSS
5	(Warthadi et al., 2022)	Jambura Health and Sport Journal	Google Scholar	Experimental Method	One group pretest-posttest design	Total Sampling	T-test
6	(Khapipudin et al., 2021)	Gelora:	Garuda	Experimental Method	One grup pretest-posttest design	Total Sampling	T-test
7	(Zainuddin & Muhammad Yusuf, 2022)	Jurnal Ilmiah Mandala Education	Sinta	Experimental Method	One group preetest-posttest design	Total Sampling	T-test
8	(Irfan & Kasman, 2021)	Musamus: Journal of Physical Education and Sport	Sinta	Experimental Method	One group preetest-posttest design	Total Sampling	T-tes
9	(Nugroho & Kusuma, 2022)	Jurnal Prestasi Olahraga	Sinta	Experimental Method	Two group pretest-posttest design	Total sampling	Paired sample t-test and independent sample t-test

10	(Darmawan & Jatmiko, 2020)	Jurnal Prestasi Olahraga	Sinta	Experimental Method	Two groups eksperimental design.	Total sampling	Uji paired sample t-test,
11	(Brastangkara & Jatmiko, 2019)	Jurnal Prestasi Olahraga	Sinta	Experimental Method	Two Group Pre and Post Test	Purposive Sampling	SPSS application
12	(Alkayis & Soedjatmiko, 2019)	Journal of Sport Coaching and Physical Education	Sinta	Experimental Method	Two group pretest and posttest design.	Total Sampling	Kolmogorov –Smirnov test and the Chi-Square test.

Table 2 Findings of the Reviewed Articles

No	Author & Year	Total Respon-dents	Age	Location	Type of Exercise	Study Purpose	Key Findings
1	(Septiaji, Arif; P., Muhammad Yusuf; Marzuki, 2021)	11 Particip-ants	18-23 Years Old	Mataram	Futsal	To determine whether High-Intensity Interval Training (HIIT) has an effect on increasing VO2Max among futsal athletes at UNDIKMA in 2020.	The use of HIIT to significantly affected the improvemen-t of VO2Max
2	(Wibowo , 2020)	20 Particip-ants	13-15 Years Old	Surabaya	Basket Ball	To analyze the impact of the HIIT training method on agility, speed, and	Significant effect of HIIT on improving agility, speed, and cardiovascu

						cardiovascular endurance.	l-ar endurance.
3	(Wirawan & Griadhi, 2020)	16 Particip-ants	21 Years Old	Bali	-	To determine the differences between moderate-intensity aerobic training and High-Intensity Interval Training (HIIT).	Performing aerobic exercise, either at high or moderate intensity, can lead to improvements in physical fitness.
4	(Windiastoni & Haritsah, 2019)	60 Particip-ants	15-19 Years Old	Surakarta	-	To identify the impact of HIIT training on the cardiorespiratory fitness in adolescents.	HIIT can improve cardiorespir-atory fitness in adolescents.
5	(Warthadi et al., 2022)	16 Particip-ants	18-23 Years Old	Surakarta	Indonesian Martial Art	To determine the effect of HIIT on lower-extremity strength endurance in Pencak Silat athletes at Muhammadiyah University of Surakarta.	It can be concluded that Strength HIIT training can improve strength endurance in competitive compared to before
6	(Khapipudin et al., 2021)	15 Particip-ants	16-18 Years Old	Mataram	Futsal	To identify the effects of HIIT training on the VO_2Max levels of futsal extracurricular students at SMAN 1 Gerung in 2021.	Significant effect of HIIT training on improving VO_2Max among futsal extracurric

							ul-ar students
7	(Zainuddin & Muhammad Yusuf, 2022)	15 Participants	16-18 Years Old	Mataram	Futsal	To determine the effect of HIIT training on the VO_2Max levels of futsal team members at SMAN 1 Narmada.	An improvement result of the training program that had been implemented.
8	(Irfan & Kasman, 2021)	22 Participants	18-23 Years Old	Merauke	Soccer	To determine whether High-Intensity Interval Training (HIIT) has an effect on VO_2Max of the soccer team at STKIP Taman Siswa Bima.	HIIT has a positive effect on the VO_2Max levels of soccer players at STKIP Taman Siswa Bima.
9	(Nugroho & Kusuma, 2022)	26 Participants	22 Years Old	Surabaya	Futsal	To investigate the effects of high-intensity interval training (HIIT) and small-sided games (SSG) oof futsal players.	There is a significant effect of HIIT SSG of aerobic endurance in futsal players.
10	(Darmawan & Jatmiko, 2020)	21 Participants	17-20 Years Old	Surabaya	-	To investigate the differences effects of HITT and Tabata of VO2Max in non-athlete students at UNESA	There is a significant effect of improvement of VO2Max.
11	(Brastangkara & Jatmiko, 2019)	24 Participants	18-23 Years Old	Surabaya	-	To determine whether high-intensity interval	There is a significant effect of HIIT on

						training (HIIT) in resting heart rate in non-athlete students.	resting heart rate in non-athlete students.
12	(Alkayis & Soedjatmiko, 2019)	14 Participants	16-18 Years Old	Slawi	Futsal	Effect of extensive and intensive interval training on VO2Max.	There is an effect of extensive and intensive interval training on VO2Max.

B. Discussion

High-intensity interval training (HIIT) is a training concept that combines high-intensity exercise with periods of low- or moderate-intensity exercise (Herlan & Komarudin, 2020). HIIT integrates high- and low-intensity components within a structured training program. It provides a strong stimulus to the cardiovascular system and muscles by alternating high-intensity efforts with recovery periods. This can result in effects such as increased VO2Max, enhanced aerobic and anaerobic capacity, improved metabolism, and reduced body fat within a relatively short period. VO2Max, or maximal oxygen capacity, refers to the body's maximum ability to take in and utilize oxygen (Gillen et al., 2016). VO2Max represents the highest amount of oxygen consumed per unit of time during exercise or competition. The higher a person's VO2Max, the better their cardiorespiratory endurance, making them more resistant to fatigue during prolonged high-intensity activity.

Adolescence is a transitional phase from childhood to adulthood (Fahrizqi et al., 2021). According to the World Health Organization (WHO), adolescents are individuals aged 12–24 years; however, if an adolescent is married, they are considered part of the adult population. Research by Denny Pratama & Sari (2021) indicates that adolescents experience optimal physical development through muscle training. In terms of cognitive development, adolescents are able to think critically and plan to solve problems. The affective stage of adolescence aligns with their physical and mental development. Psychomotor growth in adolescents progresses in accordance with body size, physiological changes, and physical abilities. This review suggests that HIIT is an appropriate training method to significantly improve VO2Max in adolescent males, consistent with their developmental characteristics. Adolescents tend to prefer sports that involve teamwork, which aligns with their developmental characteristics of enjoying group activities (Sawyer, 2018). Moreover, adolescence is a stage in which individuals develop self-confidence.

All the reviewed articles demonstrate that training using the HIIT method can improve VO2Max in athletes, despite variations in training type and duration. In

some studies, HIIT was conducted three times per week for six weeks, totaling 18 sessions (Septiaji et al., 2021; Wibowo, 2020), which had a significant impact on VO2Max improvement. A previous study by Samsudin (2018) showed that HIIT positively affected VO2Max in M2 United soccer players, with VO2Max increasing by 22.45% following training twice per week for four weeks. Another study by Riry Ambarsarie and Dessy Triana (2016) found that regular high-intensity interval training conducted by first-year students at the Faculty of Medicine and Health Sciences, University of Bengkulu, three times per week for four weeks, also resulted in a significant increase in VO2Max levels. Overall, these findings confirm that high-intensity interval training (HIIT) is a highly effective method for improving VO2Max in adolescent males.

4. Conclusion

Based on the literature review of 12 articles, the researchers found significant evidence that the HIIT training method positively impacts VO2Max improvement in adolescent males. HIIT is a highly recommended form of training due to its ease of implementation, relatively short duration, and its ability to produce significant improvements in VO2Max when performed regularly. Therefore, HIIT is recommended as an effective training method.

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