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A thematic approach to HIIT (high-intensity interval training) among the youth

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Abstract

High-Intensity Interval Training (HIIT) involves alternating between periods of intense aerobic exercise and periods of moderate or mild intensity recovery, whether passive or active. This study aims to encourage further research on HIIT and promote awareness of its benefits. This article is a compilation of information from various sources, including Internet studies, theses, and books. We utilized electronic databases to identify relevant articles on HIIT and its impact on the human body. Our investigation revealed numerous advantages of HIIT, such as calorie burning, enhancement of muscle mass, improvement of endurance, promotion of a healthy heart, assistance in managing diabetes, enhancement of both aerobic and anaerobic capacities, and increased explosive strength. This research leads to the conclusion that engaging in HIIT is highly advantageous for maintaining good health. It is recommended to incorporate some form of HIIT into one's routine at least twice a week.

Keywords: High-intensity interval training, HIIT, Exercise, training program

1. Introduction

High-intensity interval training (HIIT) involves alternating between periods of intense aerobic exercise and periods of passive or active moderate/mild intensity recovery (Fox *et al.*, 1973) ^[11]. The key advantage lies in its ability to sustain high-intensity exercise for longer durations compared to continuous exercise. This results in a more significant training stimulus, leading to improvements in maximal aerobic capacity. Both central and peripheral adaptations induced by HIIT have been clearly observed in healthy individuals. HIIT is particularly noteworthy because high-intensity exercise (85-100% of peak oxygen uptake [VO₂peak]) not only enhances limiting factors and VO₂peak but is also more effective than moderate-intensity continuous exercise (MICE) in improving cardiovascular risk factors. The clinical implications are significant as VO₂peak serves as a strong independent predictor of morbimortality in patients with coronary artery disease (CAD) and heart failure (HF). Moreover, controlling risk factors such as diabetes, dyslipidemia, being overweight, and hypertension is a crucial aspect of secondary prevention in these patients (Guiraud *et al.*, 2012) ^[12]. The premature mortality risk in individuals is heightened by the early emergence of cardiometabolic risk factors during youth. Factors such as insufficient physical activity, overweight or obesity, unhealthy diet, low cardiorespiratory fitness, hypertension, chronic inflammation, and dyslipidemia are observable in youth and may persist into adulthood. Adolescence is a crucial period for the establishment of healthy behaviors. Research by Dumith *et al.*, involving 26 cross-sectional studies, reveals a significant 65% average decrease in physical activity during adolescence. Given the increasing prevalence of chronic diseases, it is crucial to implement strategies for enhancing cardiometabolic health in youth (Logan *et al.*, 2014) ^[17].

In contrast to continuous aerobic exercise, high-intensity interval training (HIIT) has gained popularity as an alternative. HIIT involves short bursts of intense sprinting followed by recovery intervals at a lower to moderate intensity, offering a time-efficient approach to reaping exercise benefits. Lack of time is often cited as a major obstacle to exercise participation. HIIT has demonstrated superior efficacy in improving cardiometabolic risk profiles compared to continuous aerobic exercise in various populations, including healthy individuals, those with obesity, and individuals with type 2 diabetes. It has also proven to be a more effective method for restoring vascular function in heart disease patients.

Ongoing research suggests that vigorous-intensity physical activity contributes to the regulation of healthy metabolic profiles, irrespective of weight loss and energy expenditure. This implies the existence of metabolic mechanisms responsive to high-intensity body movement (Logan *et al.*, 2014)^[17].

2. Materials and Methods

We searched electronic databases to find all relevant articles concerning the relationship between High-Intensity Interval Training (HIIT) and fat mass. We conducted a stratified analysis based on the type of HIIT (cycling or running, target intensity), gender and/or body weight, and the techniques used to measure body composition. Additionally, we assessed heterogeneity.

2.1 Significance of High-Intensity Interval Training (HIIT)

Interval training is essentially characterized by alternating periods of demanding exercise and recovery. However, the definition of "high intensity" in exercise varies among research publications, and there is no universally agreed-upon threshold for categorizing training loads as 'close to maximal effort.' The literature uses terms like "high intensity" or "vigorous" in a diverse manner, encompassing efforts ranging from 65% to 170% of peak power output or measured power at $\dot{V}O_2\max$. Additionally, different publications may use various reference dimensions, such as peak power output percentage, power or velocity percentage of $\dot{V}O_2\max$, maximal heart rate percentage, and critical/maximal velocity percentage. The use of different reference dimensions can be problematic as the same numerical values may indicate different metabolic demands. Commonly, intensity levels are associated with a workload corresponding to $\geq 90\%$ of maximal aerobic capacity or maximal effort, with Buchheit and Laursen highlighting nine characteristics that precisely describe high-intensity interval training (HIIT), including interval intensity and duration, relief interval intensity, and duration, exercise modality, number of reps and series, and recovery duration and intensity between series.

2.2 Advantages of High-Intensity Interval Training (HIIT)

High-Intensity Interval Training (HIIT) is an efficient approach for reducing fat deposits, including those in the abdominal and visceral regions (Maillard *et al.*, 2018)^[18].

2.2.1 High-Intensity Interval Training (HIIT) has the potential to torch a significant number of calories within a brief timeframe

You can effectively expend calories through High-Intensity Interval Training (HIIT), as demonstrated by studies (Falcone *et al.*, 2015; Wood *et al.*, 2016)^[8, 32]. In a comparative analysis of calorie expenditure during 30-minute sessions of HIIT, weight training, running, and biking, researchers observed that HIIT resulted in 25-30% more calories burned compared to the other exercise modalities (Falcone *et al.*, 2015)^[8]. In this particular study, a single HIIT repetition involved 20 seconds of maximum effort followed by 40 seconds of rest, resulting in participants exercising for only one-third of the time compared to the running and biking groups. Despite all sessions lasting 30 minutes, HIIT workouts are commonly

shorter than traditional exercise sessions, allowing individuals to burn a similar number of calories in less time. Therefore, HIIT has the potential to either surpass traditional exercise in calorie burning or achieve equivalent results in a more time-efficient manner.

2.2.2 Enhances Metabolism

After completing a session of High-Intensity Interval Training (HIIT), one of the ways it contributes to calorie burning becomes evident. Numerous studies, including those by Panissa *et al.* (2021)^[28], Schubert *et al.* (2017)^[29], and Wingfield *et al.* (2015)^[30], have highlighted HIIT's remarkable ability to boost metabolic rate for an extended period post-exercise. Some researchers argue that HIIT may be more effective in increasing post-exercise metabolism compared to traditional activities like jogging or weight training, as indicated by Panissa *et al.* (2021)^[28]. Additionally, this study suggests that HIIT has the potential to shift the body's metabolism towards utilizing fat for energy instead of carbohydrates. The heightened intensity of HIIT workouts leads to an extended elevation of metabolism, resulting in the burning of extra calories even after the exercise session has concluded.

2.2.3 High-Intensity Interval Training (HIIT) Helps Decrease Body Fat

Research has demonstrated that High-Intensity Interval Training (HIIT) is effective in promoting fat loss. A review of 13 experiments involving 424 adults with overweight or obesity revealed that both HIIT and traditional moderate-intensity exercise can lead to reductions in body fat and waist circumference (Wewege *et al.*, 2017)^[31]. Additionally, various other studies support the notion that HIIT can effectively decrease body fat within a relatively short time frame (Atakan *et al.*, 2021; Fisher *et al.*, 2015)^[2, 9]. However, it's worth noting that, like other exercise forms, HIIT may be particularly beneficial for fat loss in individuals with overweight or obesity (Batacan *et al.*, 2017; Martins *et al.*, 2016)^[3, 19]. High-intensity intervals have been shown to achieve comparable fat loss results to traditional endurance exercise, even with a significantly reduced time commitment, and they can also contribute to a reduction in waist circumference.

2.2.4 High-Intensity Interval Training Enhances Muscle Mass

In addition to its role in promoting fat loss, High-Intensity Interval Training (HIIT) may contribute to the augmentation of muscle mass in specific individuals (Callahan *et al.*, 2021; Martins *et al.*, 2016; Naimo *et al.*, 2014)^[4, 19, 20]. Nevertheless, the increase in muscle mass is primarily observed in the muscles that are predominantly engaged, often those located in the trunk and legs (Martins *et al.*, 2016)^[19]. Furthermore, individuals who were initially less active are more likely to experience gains in muscle mass through HIIT (Damas *et al.*, 2015)^[6]. Conversely, some studies involving active individuals have not demonstrated a significant increase in muscle mass following HIIT programs (Forbes *et al.*, 2017)^[10]. While weight training remains the established benchmark for enhancing muscle mass, HIIT may provide a modest level of support for muscle growth (Damas *et al.*, 2015)^[6]. If one is relatively inactive, starting HIIT could lead to some muscle gains, although not to the extent achievable through weight

training. The augmentation of muscle mass is known to enhance strength, and improved muscle strength is conducive to the performance of specific tasks (Das & Jhajharia, 2022)^[7].

2.2.5 High-Intensity Interval Training Enhances Endurance Capacity

Muscular oxygen consumption refers to the capacity of your muscles to utilize oxygen, and endurance training is commonly employed to enhance this capability. Traditionally, this involves extended periods of continuous running or cycling at a consistent pace. However, research suggests that High-Intensity Interval Training (HIIT) can yield comparable benefits in a shorter timeframe (Batacan *et al.*, 2017; Hwang *et al.*, 2016; Martins *et al.*, 2016)^[3, 13, 19]. A study discovered that individuals engaging in 20-minute HIIT sessions four times a week for five weeks demonstrated a 9% improvement in oxygen consumption (Kong, Fan, *et al.*, 2016)^[15], a result nearly identical to the group in the study that engaged in continuous 40-minute cycling sessions four times a week. Another study found that 8 weeks of either traditional exercise or HIIT on a stationary bike increased oxygen consumption by approximately 25% (Skutnik *et al.*, 2016)^[22]. Notably, the total exercise time differed significantly between the groups: 120 minutes weekly for traditional exercise versus only 60 minutes per week for HIIT. Further studies, including Forbes *et al.* (2017)^[10] and Smith *et al.* (2009)^[23], also support the idea that HIIT can enhance oxygen consumption. In summary, High-Intensity Interval Training has the potential to improve oxygen consumption as effectively as traditional endurance training, even with half the exercise duration.

2.2.6 Engaging in High-Intensity Interval Training (HIIT) contributes to the promotion of cardiovascular health and the mitigation of hypertension

HIIT may offer significant health advantages. Numerous studies suggest its potential to lower heart rate and blood pressure, particularly in individuals dealing with overweight or obesity, a demographic where elevated blood pressure is prevalent (Batacan *et al.*, 2017)^[3]. A specific investigation demonstrated that an 8-week HIIT program on a stationary bike resulted in blood pressure reduction comparable to that achieved through traditional continuous endurance training among adults with high blood pressure (Skutnik *et al.*, 2016)^[22]. In this trial, the endurance training group engaged in exercise four times a week for 30 minutes daily, while the HIIT group exercised only three times a week for 20 minutes per session. Some researchers propose that HIIT might be more effective in reducing blood pressure than the commonly recommended moderate-intensity exercise (Clark *et al.*, 2020)^[5]. Nevertheless, it seems that high-intensity exercise typically does not induce notable changes in blood pressure for individuals within the "normal" BMI range with normal blood pressure (Batacan *et al.*, 2017)^[3]. The evidence suggests that HIIT's positive impact on blood pressure and heart rate is most prominent in individuals who are overweight or obese and also have high blood pressure.

2.2.7 High-Intensity Interval Training (HIIT) is effective for regulating blood glucose levels

High-Intensity Interval Training (HIIT) programs lasting less than 12 weeks have been shown to lower blood sugar

levels (Kong, Sun, *et al.*, 2016)^[16]. A compilation of 50 studies revealed that HIIT not only decreases blood sugar but also enhances insulin resistance more effectively than traditional continuous exercise (Jelleyman *et al.*, 2015)^[14]. This information suggests that high-intensity exercise could be particularly advantageous for individuals at risk of developing type 2 diabetes. Some studies, specifically conducted on people with type 2 diabetes, have illustrated the efficacy of HIIT in improving blood sugar levels (Alkhatib *et al.*, 2017)^[1]. Nevertheless, research on healthy individuals indicates that HIIT might enhance insulin resistance even more than conventional continuous exercise (Hwang *et al.*, 2016)^[13]. Thus, high-intensity interval training appears to offer notable benefits for individuals aiming to reduce blood sugar and insulin resistance, with improvements observed in both diabetic and non-diabetic populations.

2.2.8 High-Intensity Interval Training (HIIT) improves both aerobic and anaerobic capacity

While the positive impacts on health are significant, High-Intensity Interval Training (HIIT) also enhances performance in both anaerobic and aerobic activities (Ouerghi *et al.*, 2017)^[21]. Whether you are an athlete, a weekend enthusiast, or simply enjoy active moments with your children, HIIT can elevate your performance in these activities with just a few brief sessions each week. Despite its potential advantages, there are considerations for HIIT, particularly in terms of injuries, which are a common concern when initiating any exercise program, especially among elderly and sedentary individuals. Although musculoskeletal injuries may occur, they are not more prevalent in HIIT groups compared to other exercise forms, and careful selection of exercise equipment can help minimize risks. A recent systematic review found no instances of cardiac or life-threatening events across seven HIIT studies in patients with coronary artery disease, suggesting that HIIT is generally safe in controlled environments, although individual patient considerations are essential for prescription. Given the intense energy demands during HIIT interval phases, a high level of motivation is necessary. While effective in controlled trials and potentially linked to higher adherence levels, further research is needed to assess long-term adherence rates to HIIT. Importantly, as some exercise types may be unsuitable for specific patient populations and HIIT may be unfamiliar to some, certain individuals may require specific assessment or instruction in HIIT from an exercise physiologist or physiotherapist.

3. Discussion

The primary objective of this literature review was to consolidate existing research on High-Intensity Interval Training (HIIT) and determine its potential impact on various aspects of health, including body composition, cardiometabolic health, blood glucose levels, fat reduction, aerobic and anaerobic capacity, hypertension, endurance capacity, and cardiovascular health. Additionally, the review aimed to pinpoint the most effective HIIT protocol by examining session structure, intensity, frequency, and duration. In pursuit of this goal, several studies were examined, revealing evidence supporting the significant enhancement of specific health parameters in children and adolescents through HIIT. These investigations

demonstrated that HIIT can notably improve cardiorespiratory fitness, BMI, and body fat percentage when compared to moderate-intensity training. The findings suggest that HIIT is a viable and time-efficient strategy for enhancing cardiorespiratory fitness and positively influencing body composition in adolescents.

4. Conclusion

Enhancing health in children and adolescents can be efficiently achieved through high-intensity interval training (HIIT), a time-efficient approach. According to this analysis, engaging in running-based sessions, with an intensity exceeding 90% of the maximum heart rate or 100-130% of maximal aerobic velocity, two to three times weekly for a minimum duration of more than seven weeks, yields positive enhancements in various health indicators. HIIT offers numerous advantages, such as calorie burning, increased muscle mass, enhanced endurance, maintenance of a healthy heart, assistance in diabetes management, improved aerobic and anaerobic capacities, as well as heightened explosive strength. The findings of this study support the conclusion that HIIT significantly contributes to maintaining overall health, recommending a frequency of at least twice a week for any form of HIIT exercise.

5. Conflicts of interest

The authors have no conflict of interest to disclose.

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