

Prescribing Exercise Based on Critical Power is an Effective Way to Control Weight in Adults with Overweight or Obesity: a Scoping Review

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Abstract

Background

Obesity is considered one of the chronic diseases associated with an increased risk of mortality and morbidity. Nowadays, exercise is considered one of the most effective treatments for it. In recent years, various studies have been carried out to find the most effective exercise prescription.

Objective

The aim of this scoping review is to answer the question of whether increasing the intensity of exercise is an effective solution to weight loss in adults with overweight or obesity.

Method

systematic reviews and Meta-analyses from 2017 to 2022 investigated high-intensity interval training (HIIT) in adults (18–65 years old) with obesity or overweight included. The expected outcomes were weight, body mass index (BMI), and total and abdominal fat mass.

Results

A total of four systematic reviews which included 165 RCT and 4427 participants were included. Long term-HIIT was effective in decreasing body weight, body mass index (BMI), and total and abdominal fat mass.

Conclusion

HIIT is a time-efficient exercise prescription to reduce weight, BMI, waist circumference (WC), and total and abdominal fat mass, however, the outcomes were similar and no significant differences were found compared to moderate intensity continuous training (MICT). The lack of time can be compensated for by increasing the intensity, but this is not the most effective option with the most effects, so according to the physiology of exercise, perhaps the most effective solution for losing weight is to prescribe exercises tailored to each person's physiology and based on critical power.

Keywords: high-intensity interval training; interval training; exercise; obesity; fat mass; body composition

Introduction

Obesity is one of the growing problems worldwide, and according to the latest available statistics more than one-third of adults are obese [1]. Obesity is generally classified into two groups: android obesity and gynecoid obesity.

Android obesity, also known as visceral obesity, indicates an increase in fat around the chest and abdominal cavities; this type of obesity increases the risk of metabolic disorders and mortality compared to individuals who have gynecoid obesity (fat distribution in the hips and thighs) [2]. Therefore,

weight control should pay, special attention to the reduction of visceral fat as a health factor. According to physiology, exercise and increasing aerobic fitness, can push muscle metabolism toward fat [3]. Based on this hypothesis, exercise is expected to be even more effective than a hypocaloric diet in reducing body fat [4].

The WHO and the American College of Sports Medicine (ACSM) recommended 75–150 minutes of exercise per week to maintain health, which can be increased to more than one hour per day if weight loss is desired [5]. The problem that always arises with exercise and restrictions is time, therefore; the limiting factor of time; should be considered when prescribing exercise, in addition to the issue of dose response and pleasure [6–9].

Two important and controversial issues in prescribing exercise are the intensity and duration of exercise. In recent years, the use of a specific exercise method called high-intensity interval training (HIIT) has been considered [10, 11]. HIIT is defined as short, 4-minute bouts of high-intensity exercise (greater than 90% maximal heart rate (HR) or 85% of HR reserve) followed by 3-minute rest or active recovery periods [12, 13]. This hypothesis about HIIT states that catecholamine release in the body increases after intense exercise, and because B-adrenergic receptors are located on adipose tissue, it is expected that there will be a greater reduction in adipose tissue during high-intensity exercise. Another common training method recommended for weight loss is the moderate-intensity continuous training (MICT), an endurance training method that continues to train at moderate intensity (40–60% HR reserve) [14].

To date, many studies have been conducted comparing these two training methods (HIIT vs. MICT) and their effects on weight management [15–19]. In addition, many reviews have compared and summarized the advantages and disadvantages of these two methods [14, 20–26]

In this study, we decided to summarize the most efficient exercise prescription for weight management in adults with overweight or obesity, emphasizing the visceral adipose tissue reduction approach as an important health aspect.

2. Evidence Acquisition

Procedure

This study is a scoping review; the study was conducted in five stages, which are: identify research question, identify relevant studies, study selection, charting the data, collating summarizing and reporting the results [27]

Research question

Is high-intensity interval training the most effective exercise prescription to lose weight for adults with obesity?

Database search

Relevant studies published between 2017 and 2022 were searched using the PubMed, Cochrane, Science Direct and Google Scholar search engines. The following search terms were used across all search engines: (high intensity interval training OR interval training OR exercise) AND (obesity OR fat mass OR weight loss OR body composition)

Screening

Three steps were taken to select the appropriate articles. In the first step, after the initial search, the articles related to the topic were selected based on the title. Then, the abstracts of the articles were reviewed by two reviewers, and if approved based on the inclusion and exclusion criteria, they moved to the final stage. In this step, access to the full text and the English language of the article were included in the assessment.

The inclusion criteria were studies analysing adults of both sexes (aged 18–65 years old) with overweight (BMI over 25kg/m²) or obesity (BMI over 30kg/m²) who combined HIIT intervention (intensity over 80% VO₂max) with other types of exercise prescription, particularly MICT.

Exclusion criteria were studies that used other interventions such as diet, medication, and supplements together with exercise. In addition, studies of obesity in specific disease groups such as diabetes, sarcopenia, cancer survivors, pregnancy and osteoarthritis were excluded from this study.

Study selection

3431 articles were found using the above keywords. We used Endnote software to organise the articles. In a first step, 988 articles were removed due to duplication. Then, 2332 articles were removed by checking the titles of the articles. Of the remaining 111 articles, 107 articles were removed after a detailed review of the summary of the articles. Finally, four articles were selected and evaluated by two reviewers (Figure 1).

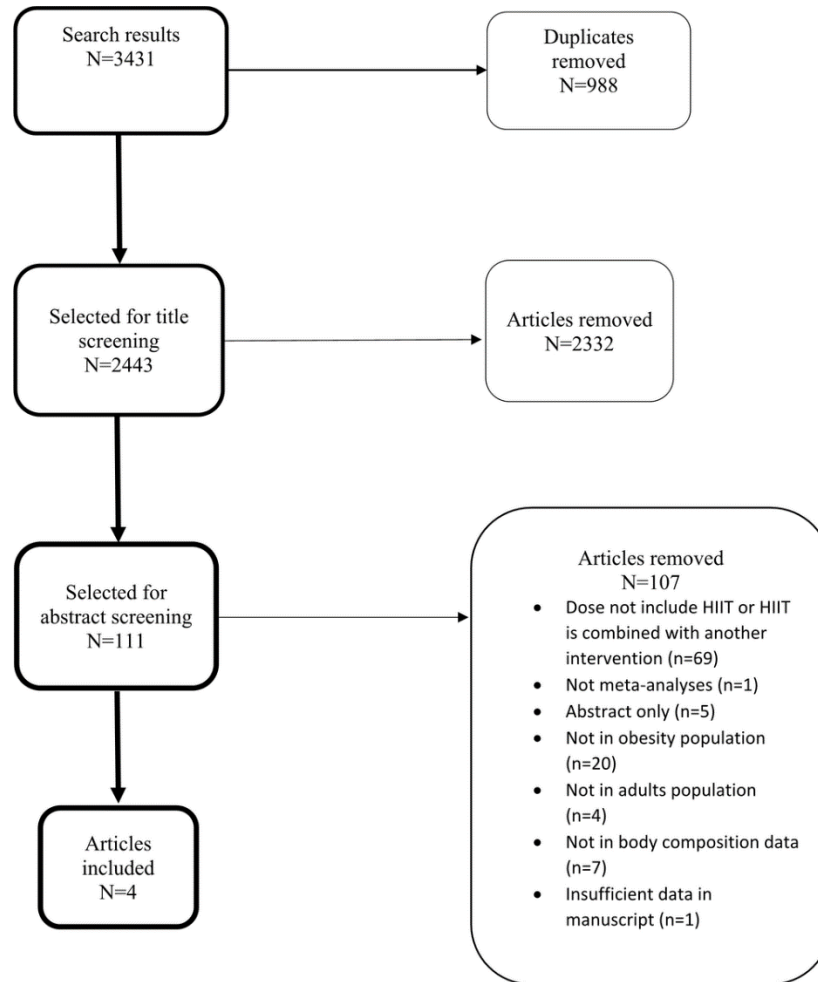


Figure 1: flow chart of the study selection process

Charting the data, collating and summarizing the results

The data on all included studies are summarised in Table No. 1

study	Sample size	intervention	outcome
Andreato (22)	48 RCT	HIIT (more than 80% vo2max) Vs. MICT	WHR, BF%, WC, BMI, abdominal subcutaneous fat area, abdominal visceral fat area decreased as the same as MICT Body mass decreased but greater in MICT when studies not equalized and HIIT superior when studies equalized.
Wewege (14)	13 RCT	HIIT (more than 85% HR max) Vs. MICT 8–10 week	BF% and WC decreased as the same as MICT
Maillard (21)	39 RCT	HIIT (80–100% HR peak) 12 weeks	Total fat mass, abdominal and visceral fat mass decreased
Batacan (20)	65 RCT	LT-HIIT (more than 85% Vo2 max) Vs. ST-HIIT	WC and body fat decreased in LT-HIIT but only WC decreased in ST-HIIT

Table 1: A summary of studies and their outcomes on the effect of HIIT on people with obesity

HIIT (high intensity interval training), MICT (moderate intensity continuous training), LT-HIIT (long term more than 12 weeks-high intensity interval training), ST-HII (short term less than 12 weeks-high intensity interval training), BMI (body mass index), WHR (waist hip ratio), BF% (body fat percentage), WC (waist circumference)

3. Results

This study is a review of the effectiveness of the HIIT method in weight loss. This review included four systematic reviews involving 165 RCT and a total of 4427 participants. All studies were conducted in adults (18–65 years old)

who were obese or overweight (BMI over 25kg/m²), but two studies were conducted in both obese and non-obese participants [20, 21].

In general, HIIT is an exercise protocol with an intensity greater than 90% VO₂max [5], but in this review we considered exercise with an intensity greater than 80% VO₂max or HR peak as HIIT; because exercise with an intensity of 90%VO₂max or more requires a high level of physical fitness, which may not be present in the normal population. The average frequency of this protocol is 95 min/week. Most protocols have taken the form of 4 min of high-intensity exercise and 3 min of active recovery at moderate or lower intensity, but in some studies high-intensity exercise performed for only 1 min or less [21].

MICT is another intervention compared to HIIT in this study. MICT is defined as training at an intensity of 40–60% VO₂max or HRR for an average of 158 minutes/week.

The duration of training prescriptions averaged more than eight weeks in all studies, and one study compared long-term (LT)-HIIT (more than 12 weeks) with short-term (ST)-HIIT (less than 12 weeks) [20].

The main finding of this study is that HIIT is a time-efficient protocol for reducing body weight, BMI, waist circumference (WC), waist-hip ratio (WHR), body fat percentage (PBF), abdominal fat mass, and visceral fat mass with no significant difference between HIIT and MICT; However, in one study MICT decreased body mass [0.4 [95% CI: 0.09 to 0.72 kg]; p for heterogeneity: 0.002] greater than HIIT when the protocols not equalized, but in equalized studies HIIT was superior in body mass reduction [-0.41 kg [95% CI: -0.79 to -0.02 kg]; p for heterogeneity: 0.97], but this difference may be clinically irrelevant [22].

This review confirmed that after eight weeks of high-intensity training, PBF was reduced by about two kg and waist circumference by about three cm, with no difference from moderate-intensity training.

Running is more effective in reducing total fat mass and visceral fat mass according to studies [14, 21], but further comparisons need to be made to determine the more significant effect of cycling in reducing abdominal fat mass in the meta-analysis by Maillard et al.

According to the meta-analysis by Batacan et al., at least 12 weeks of HIIT are required to reduce WC and total body fat [20].

4. Conclusions

According to this review, HIIT and MICT have the same effect in improving body composition in people with overweight or obesity, but HIIT is a time-efficient protocol (HIIT for an average of 95 minutes/week compared to MICT, which is performed for about 158 minutes/week). Therefore, despite the greater effect of MICT on body mass in some studies [22], it can be concluded that HIIT is the better choice for people with limited time.

Frequency	Intensity	Time	Type
5 day/week Start with 3 days if sedentary before	Moderate intensity 40–60% HRR	50–60 minute per session Start with 30 min if sedentary before	running
By increasing the intensity and reducing the time, it is possible to achieve the desired weight loss results in people with limited time			

Table 2: Exercise prescription in adults with overweight or obesity

Declarations

All authors have no conflict of interest.

Authors did not use any financial support for this article.

Additional Declarations

No competing interests reported.

There are two mechanisms that considered to increase the effectiveness of HIIT compared to MICT. One of the mechanisms discussed earlier in the introduction is the increase in catecholamine release after intense exercise, but according to this review there was no difference between HIIT and MICT in terms of fat mass and HIIT and MICT has similar effects on adipose tissue.

Another mechanism discussed about the possibility of HIIT having a greater impact on weight management is the greater amount of excess post-exercise oxygen consumption (EPOC) compared to MICT [3]. And this increase in oxygen consumption after HIIT may lead to an increase in fat metabolism over a longer period of time after exercise. But the lack of a difference between the effectiveness of HIIT and MICT in weight management indicates that the increase in EPOC may not play a role in the effectiveness of HIIT.

Another point that can be debated about HIIT is its safety. High-intensity exercise in obese people who are likely to have led a sedentary life is one of the important factors that was not mentioned in any of these studies.

Therefore, according to the available information, it can be concluded that the most effective factor in prescribing exercise for obese people is time and increasing the intensity does not make any significant difference.

According to the concept of exercise physiology, and crossover concept, below 60% vo₂ max, fats are the main metabolic pathway, and when exercise intensity is increased above 75% vo₂ max, there is a shift towards carbohydrates as the main substrate. This concept is influenced by two items of exercise prescription: intensity and time. During endurance training, biochemical adaptations occur in muscle fibers to maximize the oxidation of lipids, including increased numbers of mitochondria, oxidative enzymes, and changes in B-oxidation and the electron transport chain [3].

Therefore, it can be said that the most effective part of a training prescription for ideal weight loss is time, and that the longer the training, the greater the adaptation of lipid metabolism.

Considering the concept of critical power, which is defined as the highest intensity of exercise for a person who can continue it for a long period of time without fatigue, an exercise prescription based on this concept provides the highest metabolic rate and may theoretically be more beneficial for weight management [3].

Currently, we know that the most effective type of exercise for weight management is running. Further, and stronger evidence is needed for elliptical training and cycling. Table NO.2

In this study, we summarized the effects of increasing intensity when prescribing exercise for adults with obesity. Increasing intensity can control and compensate for the limiting factor of time. However, HIIT is a time-efficient protocol for weight management, but the use of MICT may be safe and more appropriate for the general population.

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