SCHOLASTIC:
Journal of Natural and Medical Education
Volume 2 Issue 2, Year 2023 ISSN: 2835-303X
https://univerpubl.com/index.php/scholastic

Effects of High Intensity Interval Training (Hiit) on Cardiovascular Diseases

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Article Information

Received: December 06, 2022
Accepted: January 07, 2023
Published: February 08, 2023

Keywords: *High-intensity interval training; cardiovascular diseases, Exercise; Training; Coronary artery disease and Peak O2 consumption; Aerobic*

ABSTRACT

High-intensity interval training is easier to stick with and perform in cardiac rehabilitation due to its short-term high oxygen-consumption activity interphased with intervals of low-intensity training or rest for recovery. Time-efficient high-intensity interval training (HIIT), rather than guideline-based moderate-intensity continuous training, has been studied as an exercise training program in complete cardiac rehabilitation. According to research, high-intensity exercise improves aerobic and metabolic performance by stimulating the cardiopulmonary system and skeletal muscles more. In this small study, we looked at the risk factors for cardiovascular disease, improving cardiovascular health through exercise and high-intensity interval training (HIIT), and heart failure and HIIT. High-intensity interval training (HIIT) has been identified as an effective exercise protocol for general health and primary and secondary cardiovascular prevention using short exercise sessions. Given the variety of HIIT protocols, which can be divided into aerobic HIIT and anaerobic HIIT [usually referred to as sprint interval training (SIT)], health-care professionals such as primary care physicians and cardiologists may struggle to select an appropriate protocol for their patients. High-intensity interval training (HIIT) has emerged as a potentially beneficial alternative, involving brief bursts of high-intensity exercise interspersed with periods of rest, with the goal of increasing cardiovascular exercise intensity in a time-efficient manner. Understanding HIIT protocols and implementing the appropriate type for each participant would result in better VO+ peak improvements with higher adherence and lower risk.

1. INTRODUCTION

The World Health Organization (WHO), 2018 reports that the top cause of death worldwide is cardiovascular disease (CVD), which includes heart failure (HF) and coronary artery disease (CAD). Cardiovascular disease is still becoming more prevalent and killing more people worldwide (Du *et al*., 2021). About 17.9 million people worldwide passed away in 2019 as a result of cardiovascular disease, or 32% of all deaths (Cardiovascular diseases, 2021). According to a report on cardiovascular health and illness released in 2020 by the National Center for Cardiovascular Disease, 11.4 million people in China are thought to have coronary artery disease (CAD) (Shengshou, 2021).

Regular physical activity and exercise have been linked to amazing, widespread health benefits and are regarded as an antidote for improving treatment and lowering the risk of CVD (Nystoriak & Bhatnagar, 2018). Several long-term studies have linked increased physical activity to a lower risk of developing cardiovascular and respiratory diseases. These findings also suggest that it may slightly increase life expectancy (Nystoriak & Bhatnagar, 2018). According to this theory, death rates for both men and women are inversely related to levels of cardiorespiratory fitness, even when other predictors of cardiovascular mortality, such as smoking, hypertension, and hyperlipidemia, are present (Moholdt et al., 2018).

Physical inactivity and aging both increase the risk of cardiovascular disease, with only 25% of older people in the UK meeting the minimum recommended exercise levels for health (McPhee et al., 2016). Cardiorespiratory fitness (CRF) is not only the "gold standard" of physical fitness, but it is also a recognized indicator of cardiovascular health and a predictor of both cardiovascular illness and premature death (Gonzales et al., 2021). Sarcopenia, or the age-related loss of muscle mass and function, is a significant additional risk factor for premature death in the elderly, in addition to cardiorespiratory fitness (Cruz-Jentoft et al., 2019).

Cardiac rehabilitation (CR) is a therapy strategy that plays an important role in the secondary prevention of cardiovascular disease. It consists of monitored exercise, lifestyle changes, social and psychological support, and health education (Anderson et al., 2018). In addition to the traditional cardiovascular risk factors, exercise-based cardiac rehabilitation reduces cardiovascular risk from ailments such as chronic systemic inflammation (Fiuza-Luces and colleagues, 2018). Exercise has been linked to anti-inflammatory effects, lower blood levels of C-reactive protein, increased cardiac output, stroke volume, and vascular endothelial function, as well as decreased heart rate variability in those without cardiovascular disease (Pearson and Smart, 2018).

Moderate continuous exercise (MCT) is regarded as the most well-established type of recommended exercise training due to its well-established clinical benefits and safety (Piepoli et al., 2016). Moderate-intensity continuous training (MICT) has traditionally been used as the foundation of aerobic exercise prescription, resulting in both short-and long-term clinical benefits for CVD patients (Piepoli et al., 2016). Recent research, however, shows that high-intensity interval training (HIIT) as an exercise modality has a comparable or greater impact on outcome measures when used in addition to or instead of continuous moderate exercise (Yu et al., 2022). HIIT refers to interval training that involves near-maximal efforts at intensities below VO2 peak, peak power output, or peak heart rate (Yu et al., 2022). Depending on how long each interval is, this exercise consists of short, medium, and long HIITs. Inexperienced users of these intervals, particularly cardiovascular patients, need to be closely supervised (Dun et al., 2019).

Based on the lengths of exercise and recovery, three types of high-intensity interval training have been developed (Yue et al., 2022). Long-interval high-intensity training consists of four minutes of high-intensity exercise followed by three minutes of active or passive rest (Yue et al., 2022). A medium-interval high-intensity workout consists of one to two minutes of high-intensity exercise followed by one to four minutes of low-intensity rest (Yue et al., 2022). Short-interval high training intensity consists of 15 to 60 seconds of high-intensity exercise followed by 15 to 120 seconds of low-intensity recovery (Dun et al., 2019).

Growing evidence of HIIT's effectiveness in improving metabolic and cardiovascular function in both healthy and chronically ill populations has fueled interest in this type of exercise (Batacan et al., 2017). When compared to MICT in a laboratory or clinical setting, preliminary data shows that many people are equally or more satisfied with high-intensity interval training and have at least similar overall training adherence. When compared to MICT, high-intensity interval training saves time (Vella et al., 2017).

According to several reviewers (Quindry et al., 2019), although HIIT has been shown to be effective in treating CAD patients' problems with their aerobic capacity, blood pressure, body composition, and quality of life, as well as in CR, only changes in peak VO2 have been studied in comparison to MICT, and there has been no work done and inconsistent results in the past regarding parameters of their cardiorespiratory, risk factor, and other systems (Du et al., 2021). Similarly, there is currently no clear consensus on the optimal HIIT prescriptive variables that yield the greatest benefits for patients at high risk of or with overt CVD (Dun et al., 2019).

Furthermore, recent papers contain additional relevant randomized control trials that have not yet been examined in the current review. In order to address the aforementioned limitations, the usefulness and efficacy of HIIT in CAD patients must be investigated further. This will be advantageous and beneficial in developing a more focused, effective, and result-oriented prescribing exercise as well as contributing to additional alternative possibilities, which will be extremely beneficial in managing CR. This systematic review focuses on the physical health benefits of HIIT in CAD patients, with a particular emphasis on cardiorespiratory fitness, heart rate, blood pressure, blood lipids, left ventricular function, and quality of life.

2. MAJOR RISK FACTORS OF CARDIOVASCULAR DISEASES

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality worldwide (Virani et al., 2018). Almost half of all adults in the United States have one or more major CVD risk factors, such as hypertension, high cholesterol, or smoking. Arrhythmias, dilated, hypertrophic, or idiopathic cardiomyopathies, heart failure, and atherosclerosis are a few of the CVD disorders that affect the heart and vasculature (Blacks, 2018). These conditions can lead to potentially fatal cardiac events such as a heart attack, stroke, or cardiac arrest (American Heart Association, 2019). As a result, it is critical to develop various therapeutic methods to prevent or reduce the occurrence of CVD (Virani et al., 2018).

2.1. Obesity

Despite the fact that there are numerous causes of cardiovascular disease, obesity-related CVD is more common. This can occur for a variety of reasons, one of which is that a high-fat diet or obesity can result in hypertension (Kivimaki et al., 2017). The renin-angiotensin system is activated in obesity by the release of angiotensin II and aldosterone by abdominal subcutaneous adipose tissue (Cabandugama et al., 2017). Angiotensin II stimulates the release of anti-diuretic hormone, which promotes water reabsorption in the kidneys and causes vasoconstriction in arterioles, resulting in arteriolar resistance and increased systemic blood pressure (Schutten et al., 2017).

Blood pressure rises as a result of aldosterone's increased reabsorption of water and sodium into the blood, which increases the volume of extracellular fluid (Schutten et al., 2017). Because the renin-angiotensin system inhibits norepinephrine absorption in presynaptic sympathetic nerve terminals, resting norepinephrine concentration rises, which can raise resting heart rate and eventually lead to hypertension (Jiang et al., 2016). As a result of a positive feedback loop between the sympathetic nervous system and the renin-angiotensin system, obese people have higher blood pressure (Cabandugama et al., 2017).

2.2. Hypertension

Long-term hypertension increases left ventricular afterload, making the left ventricle work harder (Halade et al., 2017). This results in pathologic ventricular wall hypertrophy and ventricular chamber dilation, which leads to decreased myocardial function and the onset of heart failure (Halade et al., 2017). When cardiac function deteriorates, the circulatory system becomes compromised, resulting in insufficient blood flow. As a result, the body is unable to meet its physiological needs for oxygen and nutrition, resulting in tachycardia, severe exhaustion, and other complications such as lung congestion, fluid retention, and arrhythmias (Halade et al., 2017).

Heart metabolic overload, which can occur without hypertension, is another risk factor for obesity-related CVD. The heart is a "metabolic omnivore," but in the obesogenic state, particularly with insulin resistance, fatty acid absorption and utilization are noticeably increased (Taegtmeyer & Lubrano, 2014). Because the heart has a limited storage capacity, this could lead to inefficient b-oxidation and intramyocardial lipid accumulation. This results in "lipotoxicity," which worsens cardiac dysfunction due to the accumulation of excess lipids and toxic lipid metabolites (Fukushima and Lopaschuk, 2016). Patients who are not obese have impaired cardiac metabolism as well. T2D, like obesity, is characterized by elevated circulating free fatty acid levels, increased myocardial fatty acid absorption and utilization, and myocardial insulin resistance, which reduces the heart's ability to absorb and use glucose (Brahma et al., 2017).

2.3. Atherosclerosis

The most common type of CVD is atherosclerosis, which develops gradually as a result of continued exposure to an unhealthy, sedentary lifestyle, including obesity (Pinckard et al., 2019). Obesity raises blood triglyceride and LDL cholesterol levels, causing tiny plaques to form beneath the endothelial cells that line the inner surface of artery walls (Pinckard et al., 2019). Normal endothelial cells can prevent leukocytes from adhering to these plaques, but in obese people, LDL molecules are oxidized, causing endothelial cells to express adhesion molecules and chemoattractants instead (Tsoupras et al., 2018).

As a result, oxidized LDL is absorbed by macrophages, which transform into foam cells that concentrate on fatty plaques in the arteries and produce substances that promote plaque formation (Bobryshev et al., 2016). The plaques that form thicken and stiffen artery walls, decreasing blood flow (Patzelt et al., 2015). Ischemia conditions and cardiac events such as stroke, myocardial infarction (MI), or cardiac arrest can all be fatal if plaques grow large enough or thrombosis develops (Pinckard et al., 2019).

2.4. Coronary Heart Disease (CHD)

Myocardial infarction (MI) is most commonly caused by the underlying coronary heart disease (CHD) caused by atherosclerosis. CHD causes 14.9 million deaths worldwide, with fatalities increasing 19% between 2006 and 2016. (Naghavi et al., 2017). CHD surpassed lower respiratory infections in a 2017 systematic study for the Global Burden of Disease Study to take the top spot for years lost to premature death (Naghavi et al., 2017).

Despite the fact that CHD mortality appears to be decreasing in developed countries, the world's aging population, expansion, and longer-term survival rates from acute myocardial infarction (MI) are increasing the global financial burden. CHD deaths are expected to rise over the next ten years (Johansson et al., 2017). The effectiveness of secondary prevention is critical because CHD death rates, years of life lost, and the financial burden are all critical global health issues

(Johansson et al., 2017).

2.5. Heart failure

Heart failure currently affects approximately 920 000 people in the UK, the majority of whom are elderly, with incidence and prevalence rising sharply with age (Conrad et al., 2018). The average age of diagnosis is 77 years old (Conrad et al., 2018). Breathlessness, fluid retention, fatigue, and a significant reduction in exercise tolerance are just a few of the symptoms experienced by heart failure patients (Callum et al., 2020). The negative impacts of these symptoms on daily functioning, health-related quality of life, hospital admission rate, and death all result in increased healthcare costs (Ziaeian and Fonarow, 2016). The total annual cost of heart failure to the UK NHS is currently estimated to be around $1 billion, with hospitalization accounting for roughly 70% of this expenditure.

3. Improvement of Cardiovascular Health through Exercise

In addition, sedentary behavior is one of the most strongly linked risk factors to the development and progression of CVD (American Heart Association, 2019). Obesity and a consistent lack of physical activity are two indicators of a sedentary lifestyle (Young et al., 2016). The majority of CVDs that are not congenital can be treated with lifestyle therapies that increase physical activity and decrease obesity (Young et al., 2016).

3.1. Reduction of Cardiovascular Risk Factors by physical activity

Regular physical activity can help to slow the onset and progression of obesity, T2D, and CVD (Vega et al., 2017). Numerous randomized controlled trials have shown that changes in lifestyle, such as moderate physical activity and a nutritious diet, improve cardiovascular health in high-risk populations (Miele & Headley, 2017). Individuals with metabolic syndrome who completed a 4-month program of either dietary (calorie restriction) or physical activity intervention had lower adiposity, lower systolic, diastolic, and mean arterial blood pressure, and lower total and low-density lipoprotein (LDL) cholesterol lipid profiles than the control group (Pinckard et al., 2019).

Diet and exercise interventions improve cardiovascular outcomes to a similar extent (Pinckard et al., 2019). Previous research on the effects of diet and exercise on metabolic and cardiovascular health discovered that diet, exercise, or a combination of diet and exercise causes weight loss, lowers plasma triglycerides, plasma glucose, HDL levels, and blood pressure, and raises VO2max (Dandanell et al., 2017). Importantly, many of these health benefits of exercise can be seen even if you don't lose weight (Lean et al., 2018).

Exercise improves cardiovascular health in both lean and overweight normoglycemic people. A 16–20% increase in energy expenditure (of any type of exercise) without dietary intervention resulted in a 22.3% decrease in body fat mass and lower levels of LDL cholesterol, total cholesterol/HDL ratio, and C-reactive protein, all of which are risk factors for CVD (Anderson et al., 2016). Walking 19 km per week at 40–55% of one's maximum oxygen uptake (VO2peak) for 7-9 months significantly improved cardiorespiratory fitness in obese people compared to inactive people (Anderson et al., 2016).

3.2. Exercise Enhances Cardiovascular Function in CVD Patients

Exercise is an essential component of treatment for people suffering from cardiovascular diseases (Vega et al., 2017). According to a study of 63 researchers, exercise-based cardiac rehabilitation improved cardiovascular function (Anderson et al., 2016). These trials included a wide range of aerobic exercise types performed at varying intensities (from 50 to 95% VO2) and time frames (1–47 months). Overall, physical activity improved quality of life and reduced the risk of MI and CVD-related death (Anderson et al., 2016). Another study looked at people who had had revascularization surgery and had atherosclerosis.

A recent study offered tailored aerobic exercise rehabilitation programs to patients who had an acute myocardial infarction for a year after coronary intervention surgery (Zhang et al., 2018). Six months after starting the exercise rehabilitation program, the patients' ejection fraction increased (to 60.81 vs. 53% in the control group), and their capacity for activity increased, and their cardiovascular risk factors decreased (Zhang et al., 2018).

Heart failure is characterized by exercise intolerance, and until the 1950s, people with this condition were advised to stay in bed (Alvarez et al., 2016). However, it has now been established that a well-supervised rehabilitation program involving moderate-intensity exercise is safe for those suffering from heart failure, and this has now emerged as a key therapy treatment for those suffering from heart failure (Haykowsky et al., 2016). Sagar et al. (2015). Exercise training improves quality of life, lowers the risk of hospitalization, and lowers long-term mortality rates in patients with heart failure, according to meta-analyses and systematic reviews (Sagar et al., 2015).

Recent research has looked at how people with heart failure respond to high-intensity exercise. A recent study discovered that 12 weeks of high-intensity interval training (HIIT) had similar effects to moderate continuous exercise (MCE) training on left ventricular remodeling and aerobic capacity in heart failure patients with lower ejection fraction (Ellingsen et al., 2017). In contrast to both pre-training values and the MCE group, a different study found that 4 weeks of HIIT in heart failure patients with intact ejection fraction increased VO2peak and decreased diastolic dysfunction (Angadi et al., 2015).

According to this study, heart failure patients who engage in both low-and high-intensity exercise training have improved cardiovascular function, most likely due to increased endothelium-dependent vasodilation and aerobic capacity (Pearson & Smart, 2017).

4. High-intensity interval training (HIIT)

HIIT was first recommended to Japanese Olympic skaters by Izumi Tabata. HIIT workouts now alternate between short bursts of high-intensity activity and moderate-to low-intensity routines. Randomized clinical trials with small sample sizes have shown that the technique outperforms traditional continuous training in terms of increasing peak oxygen consumption (VO2 peak) (Hannan et al., 2018). Bond et al. (2017) found that high-intensity interval training (HIIT) used in physical education classes had positive effects.

HIIT can reduce CVD risk in a time-efficient manner. Adolescents' improvements in cardiorespiratory fitness and body composition are influenced positively by HIIT intervention. In comparison to moderate-intensity continuous training, high-intensity interval training has the advantages of being relatively time-efficient, producing at least as much satisfaction, and demonstrating equivalent training adherence in both laboratory and clinical settings (Vella et al., 2017).

4.1. Physiological Mechanisms by which HIIT contributes to Improved peak VO2

HIIT is a proven method for increasing peak VO2 in patients with and without CVD. However, the precise processes underlying this improvement in peak VO2 in these patients are not well understood; despite overwhelming evidence to the contrary (Van De Heyning et al., 2018). Peak VO2 is primarily determined by the oxygen transport and utilization systems, which include the respiratory (oxygen uptake from the atmosphere), heart (oxygen transport), peripheral vasculature (oxygen transport, tissue perfusion, and tissue diffusion), and skeletal muscle (oxygen extraction and utilization) (Van De Heyning et al., 2018).

4.1.1. Impact of HIIT on the respiratory system

Exercise intolerance is a common symptom of CVD, particularly in older patients with HF, and respiratory muscle dysfunction is one of its manifestations (Smith et al., 2017). Tasoulis et al. (2010) found that 12 weeks of HIIT improved respiratory muscle performance in elderly people with HF. Furthermore, it was demonstrated that 4 weeks of both HIIT and MICT resulted in significant improvements in respiratory muscle function (HIIT 43%, MICT 25%), with HIIT showing a greater improvement.

4.1.2. Impact of HIIT on the cardiovascular system

One of the early cardiac adaptations in response to exercise training has been identified as an increase (improvement) in HRV, which is likely due to improvements in intrinsic heart rate (SA node) and vagal activity (parasympathetic activity) (Rave & Fortrat, 2016). .. Alansare et al. (2018) found that 8 sessions of short-interval HIIT are more effective than MICT at improving HRV in sedentary adults. These findings suggest that HIIT may be more effective than MICT in improving cardiovascular and autonomic nervous system function in sedentary adults. However, more research is needed to extend these findings to older patients with CVD in the CR setting (Alansare et al., 2018).

Peak VO2 and flow-mediated dilation (FMD), an indicator of endothelial function, are highly correlated; people with lower FMD have lower peak VO2 levels. According to Ramos et al. (2015), 12 weeks of MICT and long-interval HIIT both increased brachial artery FMD by 2.15 and 4.31%, respectively, with HIIT showing a larger improvement. Furthermore, Mora et al. (2018) recently demonstrated that long-interval HIIT reduced arterial stiffness in individuals with metabolic syndrome after 6 months of treatment. So, while the evidence so far suggests that HIIT has the potential to improve vascular function, more research is needed to fully understand the effect of HIIT on vascular function in older patients undergoing CR (Mora et al., 2018).

4.1.3. The impact of HIIT on the skeletal muscle system

Exercise tolerance is significantly influenced by skeletal muscle total fiber number and type proportions, capillary density, mitochondrial content, and function, all of which play a role in regulating the effectiveness of oxygen extraction and utilization of energy substrates such as fat and glucose (Baum et al., 2016). In the vastus lateralis muscle of healthy adults, HIIT significantly increased total muscle fiber quantity, the proportion of type I fibers, and decreased the proportion of type IIb fibers, while the proportion of type IIa fibers remained unchanged, according to a seminal study by Simoneau et al. (1985). This was the first study to look at the impact of HIIT on skeletal muscle fiber type changes.

The results of a recent study by Tan et al. (2018) also demonstrated that 18 sessions of short-interval HIIT spread out over six weeks increased the total number of type I and II muscle fibers, capillary density, and the protein expression of cytochrome oxidase IV (a marker of skeletal muscle oxidative capacity) in overweight women. Several studies (Guadalupe-Grau et al., 2018; De Matos et al., 2018) show that HIIT improves skeletal muscle deoxygenation, a sign of oxygen extraction, as well as the content and activity of markers for glucose and fat oxidative metabolism in patients with obesity and HF (Guadalupe-Grau et al., 2018; De Matos et al., 2018).

In conclusion, HIIT is an effective method for enhancing the proportions of all types of skeletal muscle fibers, capillary density, and mitochondrial content. Although there have been very few studies in this field specifically focused on older patients with CVD, the findings must be extended to older patients in the CR environment (Dun et al., 2019).

4.2. Safety of High-intensity interval training

Anecdotal evidence suggests that clinical professionals are concerned about the safety of HIIT and acute exercise. According to research, an acute exercise session may increase the likelihood of a CVD event, which could activate platelets and result in arterial thrombosis (Whittaker et al., 2013). Haynes et al. (2018) discovered no evidence of platelet activation during an acute bout of exercise, but there was vasodilation lasting up to an hour after exercise. According to one study, this could be due to the epithelium activating as a result of compensatory shear, which could counteract the effects of platelet activation. However, this was based on a small sample of healthy middle-aged people.

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5. HEART FAILURE AND HIGH-INTENSITY INTERVAL TRAINING

Systematic reviews have shown that high-intensity interval training is both safe and superior to moderate-intensity continuous training in terms of improving VO2peak in patients with heart failure and a low ejection fraction (Gomes Neto et al., 2018; Wewege et al., 2018). Gomes Neto et al. (2018) conducted the largest of these studies, comparing high-intensity intermittent exercise to moderate-intensity continuous exercise in patients with heart failure and a reduced ejection fraction, examining 13 randomised controlled trials up to October 2017. According to the meta-analysis, high-intensity interval training significantly increased VO2peak more than moderate-intensity continuous training (Callum et al., 2020).

According to Ellingsen et al. (2017), 51% of patients in the high-intensity interval training group exercised below their target level, while 80% of patients in the moderate-intensity continuous training group exercised above their target level. As a result, the actual intensity of the exercise was only reduced by 10%. Despite being underreported, exercise intensities in either moderate-intensity continuous training or high-intensity interval training are critical factors to consider when interpreting data, developing protocols, and prescribing high-intensity interval training. Gomes Neto et al. (2018) found similar results to a previous meta-analysis that included seven randomized controlled trials.

Ellingsen et al. (2017) discovered that 51% of patients in the high-intensity interval training group exercised below their target level, while 80% of patients in the moderate-intensity continuous training group exercised above it. As a result, the actual exercise intensity was only reduced by 10%. Despite the fact that they are not frequently reported, the exercise intensities in either moderate-intensity continuous training or high-intensity interval training are critical factors to consider when interpreting data, developing protocols, and prescribing high-intensity interval training. The findings of Gomes Neto et al. (2018) are consistent with those of a previous meta-analysis that included seven randomized controlled trials.

As a result of their severe deconditioning and VO2peak levels that are considerably below threshold levels, patients with heart failure frequently require near-maximal or maximal effort to complete many daily tasks (Callum et al., 2020). For instance, Kitzman et al. (2002) discovered that a patient with heart failure's oxygen expenditure when vacuuming was equivalent to 89% of maximum exertion. The majority of research to date on time-efficient high-intensity interval training has tested "all-out" sprint protocols, which require a lot of drive and are not strictly high-intensity interval training protocols because they are not defined as maximal effort. This highlights the need for more study in this area.

It is unknown whether all-out, high-intensity interval training is feasible or transferable to patients with heart failure. Individuals with heart failure may be able to accumulate more time at higher intensity if they conduct brief bursts of exercise at a higher relative intensity followed by a period of rest or lower-intensity activity, as opposed to moderate-intensity continuous training (Callum et al 2020). In terms of interval length and intensity, there is some debate about the best high-intensity interval training regimen for patients with heart failure. Despite its obvious benefits, high-intensity interval training may not be appropriate for all patients with heart failure; however, current recommendations indicate that it may provide an additional option for those patients who believe it is feasible and appropriate for them (NICE, 2018).

Although current trials for high-intensity interval training in a heart failure population have mostly been lab- or center-based, the application and usefulness in a real-world setting are less clear (Callum et al 2020). Patients may need to undergo a cardiopulmonary exercise test before beginning cardiac rehabilitation with high-intensity interval training, but many centers may not have access to this technology, particularly in community-based cardiac rehabilitation programs (Callum et al., 2020). To meet patient needs and maximize participation in cardiac rehabilitation for patients with heart failure, it is critical to investigate alternative delivery methods and environments. This includes determining how high-intensity interval training protocols developed in the lab can be used in "real-world settings" (Callum et al., 2020).

6. CONCLUSION

Exercise is also an important therapeutic treatment for people suffering from cardiovascular disease, demonstrating the preventive and restorative effects of exercise. Exercise increased endothelial-dependent vasodilation, increased ejection fraction and exercise tolerance, improved quality of life, and decreased CVD-related mortality in CVD patients. Aerobic HIIT (submaximal intensity) appears to be feasible and low risk for those with lifestyle-related diseases, obesity, sedentary lifestyle, old age, or cardiac abnormalities when performed at their own personal intensity so far. HIIT can help patients with CAD not only improve their exercise capacity but also their prognosis. Within CR settings, HIIT is a well-liked, safe, and feasible exercise program. All patients were satisfied with HIIT and most patients found the program to be challenging and improved their confidence in exercising.

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