

Review

## The effects of exercise training on physical, physiological and psychological risk factors of patients with cardiovascular disease

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**Abstract:** *Background* — Exercise training is an important component of wellness for individuals diagnosed with cardiovascular disease (CVD). Exercise may have an effect on cardiovascular risk factors such as hypertension, lipid levels, and other associated physical, psychological, and physiological risk factors. Exercise intensity may further impact those risk factors.

*Aim* — This narrative review of the literature aims to identify the effect of regular physical exercise on modifying risk factors for CVD and increased morbidity and mortality related to CVD.

*Methods* — Published English-language papers from 2011 to 2020, available in Scopus, PubMed, Cochrane, Google Scholar, and Thompson were included in this review. Keywords for this search were exercise training, cardiovascular disease, hypertension, physical function, physiological, and psychological risk factors.

*Conclusions* — Exercise training may be a cost-effective intervention that improves the physical, physiological, and psychological risk factors and the motor function of patients with cardiovascular disease.

**Keywords:** exercise training, motor function, cognitive function, cardiovascular disease.

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### Introduction

Cardiovascular disease (CVD) has a direct impact on public health. It is the leading cause of death in Iran and the burden of this disease is great [1]. The physical and psychological factors associated with CVD may have a significant negative effect on mobility and quality of life [2,3]. Risk factors related to CVD include the physical hypertension, diabetes mellitus, lipid profiles, and endothelial dysfunction, and the psychological depression. Understanding the physical and psychological risk factors related to regular exercise training would assist the prescription of safe and effective rehabilitation programs for individuals with CVD.

Atherosclerosis, a primary contributor to CVD, can lead to serious medical complications including cerebral vascular accident and myocardial infarction [4]. Previously, atherosclerosis was recognized as a lipid disorder. Recently, atherosclerosis has been proposed to be an immune response and involve the activation of many types of cells [5]. Consistent physical activity has been shown to have a positive cardiovascular effect, including on atherosclerosis [6]. Regular exercise training has been shown to improve quality of life and decrease mortality in individuals with CVD by 27% [7]. Lack of adequate physical activity is the leading cause of cardiovascular disease (CVD) mortality, especially in developing countries [8-10].

Activity guidelines for patients with CVD include exercise at a moderate intensity for 30 min/day 4-5 times weekly [11]. For individuals with CVD, low to moderate intensity exercise has been shown to be an important component in their rehabilitation. A meta-analysis on the impact of exercise for individuals with CVD revealed that a very short period of exercise training (2.5 hours/week) had a greater positive impact on CVD risk factors than no exercise training. Further, two and a half hours of physical activity each week was effective in reducing mortality risk by 19%. Participation in 7 hours per week of moderate activity was shown to reduce the mortality risk by 24% [12].

While physiological factors associated with CVD may be mitigated with exercise, psychological factors should be considered as well. In a public survey of 419 adults with CVD, a high prevalence of depression was seen [13]. In 2009, a longitudinal study, showed that controlling blood pressure with regular exercise could mitigate some cognitive dysfunction related to CVD [14].

While previous research has shown the impact of exercise on specific physical and psychological risk factors of CVD, this narrative review aims to place a more comprehensive lens on the impact of regular physical exercise on modifying physical, physiological, and psychological risk factors for CVD and increased morbidity and mortality related to CVD.

## Methods

A narrative review of the research literature among published, English language papers from 2011 to 2020 was conducted using the terms, cardiovascular disease, exercise training, CVD, physical function, physiological function. Terms were searched in isolation and in all combinations. Data bases searched included Scopus, PubMed, Embase, Google Scholar, and Web of Sciences. Following this search, papers where the methodology or quality of data collection were unclear were excluded.

## Results

### *Effect of Exercise Training on Cardiovascular Risk Factors*

**Hypertension.** Hypertension is an important risk factors for CVD, cerebrovascular accident (CVA), heart failure, and other vascular diseases. Worldwide, nearly 54% of CVAs are related to hypertension [15].

Regular aerobic exercise has been shown to be important interventions in the prevention and treatment hypertension. A systematic review of randomized clinical trials indicated that aerobic exercise training leads to reductions in resting BP of 5-7 mmHg and the reductions appear to be more pronounced in hypertensive subjects [15].

A 2020 randomized controlled trial (RCT), showed 4 months of regular exercise training for patients with heart related issues had a positive effect on the peripheral autonomic function and hypertension [16]. Another 2020 review confirmed the positive effects of exercise training on hypertension and highlighted the importance of attention to patient safety during exercise performance [17].

**Diabetes Mellitus.** Diabetes mellitus, type 2 diabetes, is also a risk factor for CVD. Regular exercise training can improve glucose tolerance in patients with type 2 diabetes. Physical activity can increase the insulin sensitivity of tissue and decrease the glycated hemoglobin (HbA1c) [18]. Patients diagnosed with type 2 diabetes who followed a regular exercise training regime both decreased body mass and decreased the incidence of diabetes type 2 by more than 50% [19]. Additionally, regular exercise has been shown to decrease insulin resistance, lipid levels, blood pressure and weight, and improve glucose control. Exercise may also have anti-inflammatory effects, increasing IL6 and decreasing proinflammatory agents and TNF [20].

A 2017 review of 15 papers concluded exercise training had a positive effect on CVD. However, the intensity and pattern of that exercise training remain unclear for patients with CVD [20]. In a 2020 randomized controlled trial exercise was found to be a cost-effective intervention that had positive effects on both type 2 diabetes and ischemic heart diseases [21].

**Low and high-density lipids.** The levels of low and high density lipids are known as important risk factors related to CVD [22]. A 1999 meta-analysis of 31 randomized control trials showed that regular exercise positively impacted lipid levels, including low and high density lipids, triglycerides, and cholesterol. While the studies included in this meta-analysis had differing study designs, finding across studies were similar [23].

A 2016 randomized controlled trial revealed regular exercise training at moderate intensity was effective on the body composition and lipid profile of patients with coronary heart disease, a type of CVD [24]. A 2020 randomized control trial of 50 patients with CVD showed eight weeks of controlled aerobic

exercise training had a positive effective on the lipid profile of patients with CVD [25].

**Endothelial Dysfunction.** Endothelial dysfunction, another related risk factor for CVD, has been identified in individuals who do not engage in exercise training [26]. Exercise training has been have a direct impact on the endothelial system, improving the function of the heart and vessels [27]. A 2017 study showed that target-based exercise training positively affected endothelial dysfunction in patients with CVD [28]. A 2017 study found engaging in 4 weeks of regular engagement in aerobic and stretching exercise could improve could improve vascular endothelial dysfunction in patients with CVD [29].

**Depression.** Depression, while not a risk factor for CVD, is a common related experience for patients with CVD. Depression is responsible for a great global burden [30] and is also independently associated with increased cardiovascular morbidity and mortality. Increased incidence of depression among individuals with CVD may be related to the perception of impaired physical abilities and the impact the diagnosis may have on social interactions and connectedness. [31,32].

A 2019 review paper found depression is a prevalent and increasing issue that affects 10% of the general population, likely higher among patients with heart issues, including CVD [32]. The positive effect of regular exercise training on the prevention or treatment of depression has been reported. A 2018 meta-analysis of 27 randomized control trials concluded regular physical activity, including different types of exercise training, improved feelings of well-being of patients with CVD [33].

### *Application of Exercise Trainings in Cardiovascular Disease*

Exercise training is an important element in the rehabilitation of patients with CVD. It has been shown to improve physiological, psychological, and physical contributors [34]. Further, a negative correlation between aerobic training and mortality has been established [35]. Two recent meta-analyses showed the positive effects of both aerobic and resistance training on heart performance [36,37] and both aerobic and resistance training have been shown to be safe interventions. [38,39]. Specifically in cardiac rehabilitation (CR), exercise at a moderate intensity under supervision of a physician has been shown to be safe [40]. Low- to moderate-quality evidence supports that CR reduces the risk of all-cause hospital admissions and may reduce heart failure specific hospital admissions in the short term (up to 12 months). CR may confer a clinically important improvement in health-related quality of life [40].

Regular aerobic exercise training with moderate intensity has a significant impact on myocardial infarction and it should be considered as one of the most important methods to address mortality in patients with CVD [41,42]. Even a simple pattern of home-based exercise training may be effective in treating coronary artery disease [43]. A 2017 meta-analysis suggested exercise training should focus on optimizing total energy expenditure rather than on one specific training characteristic. This aim should be considered for cardiac rehabilitation as well [44].

## Conclusion

Exercise training could positively affect risk factors associated with CVD. There are certain exercise parameters that may be of greater benefit than others. Based on the findings of this study,

engaging in regular exercise could be beneficial in addressing the physical, physiological, and psychological risk factors for CVD. The pattern, timing, intensity, and volume of those exercises should be considered in their prescription. Such parameters should be used as a guide when addressing the non-pharmacological treatment of patients with CVD.

#### Conflict of Interest

The authors declare that they have no conflict of interest.

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