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LITERATURE REVIEW

The Role of Physical Activity in the Prevention of Cardiovascular Diseases – A Literature Review

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ABSTRACT

Background: Cardiovascular diseases are among the leading causes of morbidity and mortality worldwide. Their development is associated with risk factors such as hypertension, obesity, diabetes, and abnormal lipid profiles. Regular physical activity is recognized as an effective preventive factor that positively influences heart and vascular function and reduces the risk of cardiovascular diseases.
Aim: To review the scientific literature on the role of physical activity in preventing cardiovascular diseases.
Materials and Methods: A literature review was conducted using PubMed and Google Scholar, covering studies published within the last 10 years.
Results: Regular physical activity induces numerous beneficial cardiovascular adaptations. These include improved endothelial function, reduced blood pressure, increased HDL cholesterol, decreased LDL cholesterol, improved insulin sensitivity, reduced inflammation, and body weight management. Physically active individuals demonstrate higher cardiorespiratory fitness, which lowers the risk of coronary artery disease, stroke, and heart failure. Both moderate and vigorous intensity training produce positive metabolic and cardiovascular effects, limiting the development of risk factors.
Conclusions: Physical activity is a key element in cardiovascular disease prevention. Evidence indicates that regular exercise benefits both the prevention of cardiovascular conditions and the improvement of cardiovascular function in individuals with existing disorders. The literature highlights physical activity as an effective strategy to reduce cardiovascular risk and enhance overall health.
Keywords: physical activity; cardiovascular diseases; prevention; cardiac remodeling; hypertension; endothelial function; obesity; glycemic control; HbA1c; lipid profile

1. Introduction

Cardiovascular diseases (CVD) remain one of the leading causes of morbidity and mortality worldwide, representing a significant global health burden. The most important risk factors for their development include arterial hypertension, obesity, dyslipidemia, type 2 diabetes mellitus, and elevated blood cholesterol levels. These factors lead to structural and functional alterations in the cardiovascular system, increasing the risk of coronary artery disease, stroke, and heart failure [1,2,3,4].

The pathophysiology of cardiovascular diseases is complex and involves multiple metabolic and vascular mechanisms. Metabolic disturbances associated with obesity and insulin resistance contribute to endothelial dysfunction, chronic inflammation, and abnormalities in lipid metabolism. These processes promote the development of atherosclerosis and impair the normal function of blood vessels and the heart [3,5,6,7].

In addition, arterial hypertension and an unfavorable lipid profile exacerbate vascular damage and increase the likelihood of adverse cardiovascular events. In recent decades, growing attention has been paid to the role of lifestyle-related factors in the prevention and management of cardiovascular diseases. Among these, regular physical activity is considered one of the most effective non-pharmacological strategies for improving cardiovascular health. Exercise induces

numerous physiological adaptations, including improved endothelial function, regulation of blood pressure, favorable changes in lipid metabolism, and enhanced insulin sensitivity. These adaptations contribute to improved cardiovascular function and a reduced risk of disease [5,8,9,10].

The aim of this study is to review the current scientific literature on the role of physical activity in the prevention of cardiovascular diseases and to summarize the main mechanisms through which physical activity affects the cardiovascular system.

2. Epidemiology

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, accounting for approximately 18 million deaths annually, which corresponds to nearly 32% of all global deaths. A continuous increase in their prevalence has been observed, particularly in populations affected by metabolic disorders such as obesity, dyslipidaemia, type 2 diabetes, and arterial hypertension [1,2,11].

A clear relationship between age and the prevalence of cardiovascular diseases indicates their progressive nature. In individuals aged 40–60 years, these diseases affect approximately 35–40% of the population; in the 60–80 age group, the prevalence increases to 75–78%, while in those over 80 years of age, it exceeds 80% [12].

Epidemiological data indicate that cardiovascular diseases constitute an increasing global challenge, primarily driven by lifestyle-related and metabolic factors. In this context, regular physical activity represents an effective preventive strategy that can reduce the incidence, severity, and mortality associated with cardiovascular diseases worldwide [1,13,14].

3. Research Results

3.1. Cardiac Remodeling and Function: Structural and Cellular Adaptations to Physical Activity

Physical activity exerts a beneficial effect on cardiac morphology and function, and the literature distinguishes two main types of cardiac remodeling: physiological and pathological. Physiological cardiac remodeling results from regular physical exercise (e.g., endurance activities such as running or swimming) and is associated with favorable changes in the myocardium, including concentric hypertrophy of the left ventricle while maintaining the wall-to-cavity ratio, improved systolic and diastolic function, and increased cardiac output. Pathological cardiac remodeling occurs in individuals with chronic cardiovascular diseases, arterial hypertension, diabetes, or following cardiovascular events. In contrast to physiological remodeling, which enhances cardiac function and performance, pathological remodeling is associated with impaired systolic and diastolic function, abnormal left ventricular geometry, an increased risk of arrhythmias, and progressive heart failure [1,5,6,15].

At the cellular level, physiological cardiac remodeling is related to adaptations in cardiomyocytes and an increased mitochondrial density, which promotes improved cellular metabolism and more efficient energy production in the myocardium. Moreover, studies indicate that physical activity, under certain conditions, may induce the expression of cardiomyocyte proliferation markers, suggesting a direct effect of exercise on myocardial cells and supporting their metabolic and functional adaptation [6,15].

Exercise-induced cardiac remodeling leads to favorable structural and cellular adaptations that contribute to enhanced myocardial performance, more efficient energy utilization, and greater resistance to hemodynamic stress. These processes represent a key mechanism through which

physical activity supports proper cardiovascular function and plays a critical role in the prevention of cardiovascular diseases [5,6,15].

3.2. Effects of Physical Activity on Blood Pressure and Hypertension

In the management of arterial hypertension, physical exercise is currently recognized as one of the primary non-pharmacological therapeutic strategies. Regular physical activity improves vascular function, promotes proper microvascular remodeling, and normalizes capillary density. Moreover, it prevents the development of hypertension in individuals with normal blood pressure and contributes to its reduction in patients with established hypertension [11,16].

Physical activity also supports proper cardiac remodeling and reduces overall cardiovascular risk. The mechanism by which exercise lowers blood pressure is primarily related to a decrease in peripheral vascular resistance. This effect is mediated by neurohormonal adaptations and structural changes in the cardiovascular system in response to reduced sympathetic nervous system activity [11,17].

A literature review indicates that long-term physical activity leads to a reduction in resting blood pressure. Moderate to vigorous exercise performed approximately 3–5 times per week can lower blood pressure by an average of 3.4/2.4 mmHg. In individuals with established hypertension, this reduction may reach an average of 5–7 mmHg. Even small decreases in systolic blood pressure confer significant health benefits; it has been shown that a 1 mmHg reduction is associated with a lower incidence of heart failure events [3,17].

In non-pharmacological management, aerobic exercise and endurance training are particularly recommended. Aerobic exercise of moderate to high intensity plays a significant role in lowering both systolic and diastolic blood pressure. Endurance training, performed either alone or in combination with aerobic exercise, provides additional benefits in blood pressure control. Similar effects may also be achieved through resistance training with variable loads [16,17].

Implementing physical activity as part of a behavioral intervention, combined with an appropriate diet and body weight reduction, plays a crucial role in reducing the risk of cardiovascular disease development [3].

3.3. Effects on Endothelial Function

Endothelial function plays a key role in the regulation of vascular health, and microcirculatory mechanisms are essential for the long-term beneficial effects of physical activity on endothelial performance. Physical activity is considered a primary non-pharmacological preventive measure against the development of major cardiovascular events. It positively affects cardiac function, blood pressure, and several metabolic parameters. These effects are associated with a reduction in sympathetic nervous system activity, modulation of the renin–angiotensin–aldosterone system, and suppression of inflammatory processes, ultimately leading to improved endothelial function and vascular elasticity [3,18,19].

Physical exercise exerts a strong protective effect against endothelial damage [20]. This beneficial impact arises from both direct hemodynamic effects and indirect mechanisms, such as modification of cardiovascular risk factors. During physical activity, skeletal muscles consume significantly more oxygen and energy, which favorably influences myocardial contractility, heart rate, blood flow, blood pressure, and endothelium-dependent vasodilation. Endothelial cells respond to these stimuli with increased production, bioavailability, and synthesis of nitric oxide (NO) at rest and during physical activity [3]. Physical activity also increases shear stress mediated by blood flow, which stimulates endothelial NO production and prevents its degradation by reactive oxygen species, thereby enhancing endothelial function [11]. The combined action of NO and potassium ions released during muscle contraction

induces vasodilation. The direct effect of potassium ions during exercise leads to hyperpolarization of vascular smooth muscle and endothelial cells, further increasing local blood flow. Endothelial dysfunction is one of the key factors contributing to atherosclerosis, leading to the formation of subendothelial atherosclerotic plaques and, consequently, cardiovascular disease [9,18].

3.4. Effects of Physical Activity on Obesity

Obesity is one of the major risk factors for cardiovascular diseases and other chronic conditions, such as diabetes, certain types of cancer, and metabolic disorders, resulting from abnormal fat accumulation in the body [21,22].

Regular physical activity plays a crucial role in body weight regulation, counteracts excessive weight gain, and supports the maintenance of a healthy body composition. Literature indicates that most individuals should engage in moderate physical activity for approximately 150 minutes per week, which allows for the maintenance of stable body weight with changes below 3%. Combining an appropriate diet with moderate-intensity aerobic activity performed for 150–250 minutes per week enables significant weight reduction, corresponding to approximately 5% of body weight. To maintain the achieved body weight, around 250–300 minutes of physical activity per week is recommended [23,24,25,26].

Physical exercise, particularly aerobic, substantially reduces abdominal and visceral obesity. This fat distribution is associated with numerous negative health outcomes, including dyslipidemia, insulin resistance, type 2 diabetes, hypertension, and increased cardiovascular risk. Reduction of visceral fat through regular physical activity contributes to an improved metabolic profile, decreased risk of chronic diseases, and protection of the cardiovascular system, whereas peripheral fat in the limbs has relatively less significance as a risk factor [11,24,25].

Systematic analyses have shown that individuals engaging in higher levels of physical activity exhibit a more favorable body composition, lower BMI, and reduced fat mass compared to less active individuals. Increased physical activity therefore represents a key component in obesity prevention and in reducing the risk of chronic diseases and cardiovascular complications [21,22,14].

3.5. The Impact of Physical Activity on Glycemic Control and HbA1c in Type 2 Diabetes

Physical activity influences the regulation of blood glucose levels, which can be observed, among other factors, through changes in HbA1c levels and blood glucose concentration. The most commonly used forms of physical activity include aerobic, resistance, and multicomponent exercises. A review of the literature has shown that both single-component and multicomponent exercises contribute to the improvement of the health status of patients with type 2 diabetes [26,27,28].

Aerobic exercise improves the utilization of glucose by the body through increased mitochondrial activity and the intensification of oxidative processes, whereas resistance training promotes increased glycogen storage in the muscles. The combined effects of these mechanisms lead to improved control of blood glucose levels through the reduction of insulin resistance and improvement of glucose metabolism [26,27,28].

However, previous studies indicate that multicomponent exercise may provide greater metabolic benefits than single-component training. A review of the literature demonstrated that training programs combining different forms of physical activity lead to a greater reduction in HbA1c levels — on average about 0.19% more compared with resistance training and about 0.11% more compared with aerobic exercise performed separately [26,27,28].

Among individuals with already diagnosed type 2 diabetes, cardiovascular diseases account for approximately 50–80% of all mortality cases, representing a significantly higher rate compared with the population without this disease [26]. One of the factors increasing the risk of these complications is an elevated HbA1c level. Therefore, physical activity is considered an important non-pharmacological method supporting the treatment of type 2 diabetes and reducing the risk of complications. Some studies have shown that the effect of regular physical activity on lowering HbA1c levels may be comparable to the effects achieved during pharmacological treatment with metformin [26,27,28].

3.6. Effects of Physical Activity on Lipid Profile

Lipid profile disorders constitute one of the major risk factors for the development of cardiovascular diseases. Their regulation plays a crucial role in both the prevention and management of these conditions [29,30].

A review of the literature emphasizes that physical activity contributes to an increase in high-density lipoprotein (HDL) levels, a reduction in low-density lipoprotein (LDL) levels, and a decrease in triglycerides, thereby improving the overall lipid profile [29]. Particularly beneficial effects are observed with regular aerobic exercise, which contributes to the reduction of total cholesterol, enhances lipid parameters, and lowers the risk of cardiovascular complications [30,31,32].

Physical activity influences not only the quantitative changes in serum lipid concentrations but also the quality and functionality of HDL particles. Regular exercise promotes HDL maturation and improves their composition and biological properties. Physical activity can also affect HDL subclasses, especially by increasing the proportion of large HDL particles, which are considered protective for the cardiovascular system [29,31,32].

The mechanisms underlying the beneficial effects of physical activity on the lipid profile are associated, among other factors, with the stimulation of lipolysis and the activation of enzymes involved in lipid metabolism. The literature indicates that improvements in lipid parameters may result from the activation of lipolytic processes induced by physical activity, leading to decreased triglyceride and LDL levels and increased HDL levels. Additionally, physical activity can stimulate the activity of peripheral enzymes, such as lecithin-cholesterol acyltransferase, lipoprotein lipase, and hepatic lipase, which play key roles in the regulation of lipoprotein metabolism [30,31].

In summary, evidence from the literature clearly indicates that regular physical activity exerts a significant impact on the lipid profile by enhancing lipoprotein metabolism, increasing HDL levels, and reducing LDL and triglyceride levels. These changes are of considerable importance in reducing the risk of cardiovascular disease development [30,31,32].

4. Discussion

This literature review provides a comprehensive analysis of the impact of physical activity on cardiovascular system function and selected metabolic parameters. The obtained results indicate that regular physical activity exerts a multifaceted beneficial effect on the body, encompassing both structural and functional adaptations of the myocardium, as well as changes in blood pressure, endothelial function, body weight, glycemic control, and lipid profile.

The results highlight significant differences between physiological and pathological cardiac remodeling. Regular physical activity induces physiological cardiac adaptations, including improvements in systolic and diastolic function, enhanced cardiac performance, and favorable structural and cellular changes. At the cellular level, an increased mitochondrial density and

cardiomyocyte adaptations are observed, contributing to more efficient myocardial energy metabolism. In contrast to pathological remodeling, these changes support proper cardiovascular function and represent an important protective mechanism.

Another important aspect is the effect of physical activity on blood pressure. Regular exercise leads to reductions in both systolic and diastolic blood pressure, primarily due to decreased peripheral vascular resistance and favorable neurohormonal adaptations. Of particular importance is the reduction in sympathetic nervous system activity and the improvement of vascular function. It has been shown that even moderate, systematic physical activity can lead to clinically significant reductions in blood pressure values, thereby contributing to a decreased risk of cardiovascular events.

A significant role of physical activity is also observed in the context of endothelial function. Regular exercise improves nitric oxide (NO) bioavailability, enhances blood flow, and increases shear stress, which stimulates endothelial function. Additionally, physical activity modulates the renin–angiotensin–aldosterone system and reduces inflammatory processes. As a result, vascular elasticity is improved, and the progression of endothelial dysfunction — one of the key factors in atherosclerosis — is limited.

Physical activity plays an essential role in the prevention and reduction of obesity. Regular exercise supports the maintenance of normal body weight and limits excessive fat accumulation, particularly visceral adiposity, which is associated with increased metabolic and cardiovascular risk. The combination of physical activity and an appropriate diet constitutes an effective strategy for weight reduction and improvement of metabolic parameters, thereby reducing the risk of chronic disease complications.

The results indicate that physical activity, including aerobic, resistance, and multicomponent exercise, improves blood glucose control and reduces HbA1c levels. The underlying mechanisms include increased insulin sensitivity, enhanced glucose utilization by skeletal muscles, and increased glycogen storage. Multicomponent exercise programs appear to provide greater benefits in reducing HbA1c compared to single-mode training interventions.

The impact of physical activity on lipid profile was analyzed. Regular physical activity leads to increased HDL cholesterol levels, decreased LDL cholesterol, and reduced triglyceride concentrations. In addition, qualitative improvements in HDL particles are observed, including an increased proportion of more protective HDL subclasses. These changes are associated with the activation of enzymes involved in lipid metabolism and enhanced lipolytic processes. Consequently, physical activity contributes to an overall improvement in lipid profile and a reduction in cardiovascular disease risk.

In summary, the findings of this literature review confirm that physical activity is a significant, multidimensional factor that positively influences cardiovascular system function and metabolic parameters. Its regular implementation should be considered an integral component of both the prevention and treatment of cardiovascular diseases due to its broad effects, including structural, hemodynamic, and metabolic adaptations.

5. Conclusions

Physical activity plays a key role in the prevention and management of cardiovascular diseases. The conducted studies indicate that regular physical activity leads to beneficial cardiac remodeling, including both structural and cellular adaptations. It has also been shown to significantly reduce systolic and diastolic blood pressure, improve endothelial function, decrease body weight, and enhance glycemic control, including HbA1c levels, in individuals

with type 2 diabetes. Furthermore, physical activity contributes to improvements in the lipid profile.

Beyond cellular and molecular adaptations, regular physical activity enhances overall physical capacity, increases endurance, and improves exercise tolerance. These benefits are universal and apply to both healthy individuals and those at elevated cardiovascular risk or with established disease.

The incorporation of regular, appropriately planned physical activity into daily life should be considered a fundamental strategy for both the prevention and treatment of cardiovascular diseases. In light of the growing burden of cardiovascular conditions, promoting physical activity remains one of the most effective and accessible tools for improving population-level cardiovascular health.

Disclosure

The authors report no disclosures.

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