




Review Article

The Role of Aerobic Exercise to Prevent Coronary Artery DiseaseF. M. Abidanovanty¹, N. S. Fairuz Zen¹, F. Rahmaputri¹, D. Tinduh^{2*} ¹Faculty of Medicine, Universitas Airlangga.²Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo General Hospital.

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ABSTRACT

Coronary Artery Disease (CAD) is a disorder of the heart function caused by blockage or narrowing of the coronary arteries so that there is an insufficiency of blood and oxygen flow to the myocardium and becomes the leading cause of death in the world. CAD is one of the causes of the decline in the quality of life of a human being. This study used a literature review method using 11 scientific articles as online data sources which were then further analyzed. Exercise is a recommended therapy as half of the pharmacotherapy. Moderate intensity exercise of 150 minutes per week and vigorous-intensity of more than 75 minutes per week greatly help cardiac rehabilitation and also provide significant benefits when started within 15 days of cardiovascular symptoms appearing. From various scientific articles that have been analyzed, exercise, especially aerobic exercise, has been shown to have a good impact on people with CAD by affecting lipid metabolism, heart remodeling, insulin resistance, and endothelial function.

Introduction

Physical activity and exercise are activities that are different but related. Physical activity is an activity in the form of the body's movement that produces energy. At the same time, not all physical activity is in the category of exercise. Exercise is a structured and scheduled activity that aims to increase physical fitness. Exercises are divided into two types: aerobic exercise and resistance exercise [1]. This study will discuss more aerobic exercise. Aerobic exercise is an activity with repetitive movements involving large muscle groups performed for a long time. Examples of aerobic

exercise are walking, jogging, cycling, and swimming.

According to the European Society of Cardiology, exercise is an activity that is recommended for patients with non-ST elevation acute coronary syndrome [2]. It requires a program of intensive exercise training. In addition, intensity, mode, duration, and frequency of exercise can significantly affect the results for each individual.[3]

Coronary Artery Disease (CAD) is a disorder of the cardiac function caused by a blockage or narrowing

in the coronary arteries resulting in decreased blood flow and oxygen to the myocardium. The imbalance between the supply and demand of oxygen in the muscles of the heart can cause chest pain which is commonly referred to as angina.^[4]

CAD is the cause of death globally, estimated to represent 32,7% of all cardiovascular diseases. Based on a survey conducted by the American Heart Association (AHA) obtained 15.5 million people in America suffered from this disease ^[5]. According to the data of Indonesian Basic Health Research 2018 (Riset Kesehatan Dasar / Riskesdas 2018) shows the prevalence of CAD diagnosis by physicians in Indonesia reached 0.5% and CAD symptoms were 1.5%. The prevalence of CAD in Indonesia increased along with the increasing age of respondents.^[6]

The treatment given to patients with CAD can be in the form of pharmacotherapy using nitrate by parenteral, sublingual, buccal, oral, or transdermal; the different types of beta-blockers to reduce oxygen demand; and calcium channel blockers. If there is an acute attack, nitroglycerin sublingual 5 mg is given, which works in 1-2 minutes and can be repeated after 3-5 minutes. However, non-pharmacological therapy is also recommended to change lifestyles such as smoking cessation, regular exercise, weight loss, and regulation of blood glucose and blood pressure in diabetes and hypertension patients.^[4]

CAD could present as several symptoms, the most common is a sense of discomfort and pain in the chest (angina). It is caused by the narrowing of the arteries that restrict blood flow to the heart muscle and the whole body. This group of symptoms is most often perceived as a heart attack. The heart attack has some symptoms: angina, weakness, dizziness, nausea, cold sweat, discomfort in the shoulder or arm, and shortness of breath.^[7]

Some studies have mentioned that the quality of life of CAD patients is worse than healthy controls ^[8]. Some studies also mentioned that physical activity can lower the risk of CAD, where CAD is one of the causes of the decline of the quality of life of a human being. It could be explained by how physical activity can decrease the concentration of fibrinogen plasma and lower the risk of thrombus formation followed by the increased tissue plasminogen activator (t-PA) and decreased plasminogen activator inhibitor-1 (PAI-1), as well as a decrease in platelet adhesion or aggregation that will have an impact on reducing the risk of CAD. Therefore, this study is conducted to find out the relationship between CAD and aerobic exercise.^[9]

Discussion

Aerobic exercise can be defined as an activity that uses large muscle groups, regularly, and has rhythm. This exercise uses aerobic metabolism to produce energy in adenosine triphosphate (ATP) from amino acids, carbohydrates, and fatty acids.

Cycling, jogging/running, walking, and swimming are examples of aerobic exercises.^[10]

Inadequate lipid and lipoprotein levels are major risk factors for cardiovascular disease (CVD). Aerobic exercise accompanied by a better lifestyle is recommended to improve lipid and lipoprotein levels for all individuals, including those with CVD^[11]. Aerobic exercise, specifically in low to moderate intensity, uses aerobic metabolism to produce energy. Aerobic exercise will affect lipid metabolism performance, cardiac remodeling, insulin resistance, and endothelial function^[10]. The human body digests fat in the duodenum through pancreatic lipase that releases monoacylglycerol (MAG), diacylglycerol (DAG), and FFA until the FA long chain will be absorbed by the duodenum and reformed as triglycerides. Along with cholesterol and proteins forming kilomicros transported into the blood, the muscle cells will receive FA from the kilomicros as a form of energy at the end. Triglycerides and plasma cholesterol are transported in four main classes of lipoproteins, namely kilomicros, very-low-density lipoproteins (VLDL) rich in triglycerides, medium-density lipoproteins (IDL), low-density lipoprotein lipoproteins (LDL) rich in cholesterol, and high-density lipoproteins (HDL).^[12]

LDL performs as atherogenic and HDL is antiatherogenic, both of which have an essential role in the risk of coronary heart disease and can be

affected by physical activity^[13]. Therefore, physical activity such as aerobic exercise can control the risk factor of coronary heart disease mediated by modifications in the activity of enzymes such as LCAR, lipoprotein lipase (LPL), and hepatic-triglyceride lipase (HTGL). Physical exercise can induce lipid utilization through adipose tissue, intramuscular TG lipolysis, FA transport to muscle, and mitochondrial metabolism. Aerobic exercise and resistance training lower total cholesterol and LDL-C and increase high-density lipoprotein-cholesterol (HDL-C)^[14]. This study was demonstrated by observations of cardiovascular risk factors in runners who showed lower body mass index, C reactive proteins, TG, non-HDL-C, and HDL-C higher than control.^[15]

High-density lipoprotein cholesterol (HDL) concentrations are inversely proportional to the risk of cardiovascular disease, so exercise interventions are recommended to be prescribed to reduce the risk of cardio-metabolic complications by increasing HDL-C concentrations^[14]. Moreover, aerobic exercise also affects Apo A1 and Apo B concentrations. An increase in Apo A1 and a decrease in Apo B after exercise can better predict CAD risk than the LDL/HDL ratio.^[15]

Exercise can affect diastolic and systolic blood pressure, increase ejection fraction, improve vascular function, and increase cardiac angiogenesis and cardiac muscle mass or cardiac

hypertrophy^[16]. Cardiac hypertrophy can occur due to the heart's adaptive response to increased cardiac workload involving mechanical, hemodynamic, and hormonal factors. Adaptation response in cardiac hypertrophy could manifest as an increase in the size of cardiomyocytes, an increase in the rate of protein synthesis, and reorganization of the sarcomeric structure. The condition of cardiac hypertrophy has two meanings: physiological and pathological hypertrophy. Physiological cardiac hypertrophy can be seen in the left ventricle remodeling caused by pregnancy and exercise training. Left ventricular remodeling by a physiologic process can affect the improvement and survival of left ventricular function in encountering coronary events, decreased collagen content, decreased fibrosis, increased angiogenesis, increased myocardial antioxidant capacity, decreased mitochondrial dysfunction, and prevented cardiomyocyte apoptosis^[17]. Pathologic cardiac remodeling leads to the risk of arrhythmias and provides the effect of a progressive decrease in cardiac output, thinning of the myocardium, increased apoptosis, cardiomyocyte metabolism, and increased fibrosis.^[18]

As a risk factor modification program, moderate-intensity aerobic exercise about 5 to 6 hours a week may contribute to slight partial regression (1%-3%) in the severity of coronary atherosclerosis. The increase in endothelial vascular function is due to

acetylcholine stimulation or induced reactive hyperemia caused by increased endothelial NO synthase (eNOS) and decreased NO turnover. Prolonged endothelial NO activity caused by exercise can neutralize free radicals. In addition, endothelial function is also affected by the increase in laminar shear stress caused by increased blood flow during exercise.^[19]

Exercise can also provide anti-inflammatory effects by reducing C-reactive protein (CRP) levels by as much as 20-30% in the blood. The liver produces CRP in response to interleukin 6 (IL-6). The decrease in inflammation markers caused by exercise is not only IL-6 but also tumor-alpha necrosis (TNF- α) and fibrinogen. Increased levels of anti-inflammatory cytokines (IL-10) and mobilization of endothelial progenitor cells (EPC) occur because aerobic exercise can increase anti-atherosclerosis effects.^[19]

People who engage in exercise programs over a long period can improve cardiovascular function. It is observed in healthy subjects, especially in subjects with cardiovascular risk factors. Even in older people over 70, exercise was confirmed to lower systolic, diastolic, and median blood pressure. The health benefits of exercise, especially aerobics, are multifactorial and include biological adaptations, and other changes in social habits, such as reduced smoking and excessive amounts of alcohol consumption.^[13]

Early detection of primary risk factors and proveniences can significantly decrease morbidity and mortality due to CAD. Risk assessment and preventive therapy are joint discussions and decisions between patients and their doctors. ACC/AHA 2019 recommends risk stratification by calculating the risk of 10-year ASCVD (Atherosclerotic Cardiovascular Disease) using the Pooled Cohort Equation (PCE). In adults between 40 and 75 without a significant history of CAD, a 10-year risk should be a part of each visit. For adults between 20 and 39 years of age, assessing the risk of 10-year ASCVD at least every four to six years makes sense. Based on ASCVD scores, a 10-year risk can be classified as low risk (lower than 5%), limited risk (5 to 7.5%), medium risk (7.5 to 20%), and/or high risk (greater than 20%).^[20]

Physical activity is also an advantage to lower the risk of CAD. The moderate-intensity activity of at least 150 minutes per week and vigorous-intensity activity of more than 75 minutes per week is helpful. Cardiac rehabilitation also provides a significant advantage when started within 15 days after cardiovascular symptoms.

Conclusion

The high number of deaths due to CAD makes it the leading cause of death globally. From various scientific articles that have been analyzed, exercise has been shown to have a good impact on CAD sufferers. This is especially true for aerobic exercise

which affects lipid metabolism, heart remodeling, insulin resistance, and endothelial function. Aerobic exercise should be practiced sustainably for a long time so that it can improve cardiovascular function. It concludes that aerobic exercise positively correlates to improved cardiovascular health in CAD sufferers.

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