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THE EFFECTIVENESS OF THERAPEUTIC EXERCISE PROGRAMS IN IMPROVING CARDIOVASCULAR FITNESS IN INDIVIDUALS WITH CARDIOVASCULAR DISEASES

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Abstract

Engaging in regular physical activity that involves utilizing large muscle groups, such as walking, jogging, or swimming, leads to cardiovascular adaptations that enhance exercise

capacity, endurance, and skeletal muscular strength. Regular physical exercise also serves as a preventive measure against the development of coronary artery disease (CAD) and alleviates symptoms in those already diagnosed with cardiovascular disease. Additionally, there is evidence indicating that exercise can lower the likelihood of developing various chronic illnesses, such as type 2 diabetes, osteoporosis, obesity, depression, and breast and colon cancer. It also offers recommendations for healthcare professionals on how to implement physical activity programs for their patients and highlights areas that require further research. This statement primarily emphasizes aerobic physical activity and does not explicitly assess resistance activities, such as weight lifting. This is because the majority of studies investigating the relationship between physical activity and cardiovascular disease have mostly examined aerobic activity. The writing group has consistently used summary papers or meta-analyses to substantiate its results and suggestions wherever feasible. This research corroborates the advice given by the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) that persons should participate in at least 30 minutes of physical exercise at a moderate level or higher on most, if not all, days of the week

Keywords: physical activity, cardiovascular disease, therapeutic exercise, type 2 diabetes, review.

1. Introduction

Physical activity is characterized as any movement of the body that is generated by the skeletal muscles and leads to the use of energy beyond what is used during rest. Exercise is a kind of physical activity that is intentional, organized, repeated, and has the specific goal of improving or maintaining physical fitness. Physical fitness encompasses several components such as cardiorespiratory fitness, muscular strength, body composition, and flexibility.1 These traits are either inherent or may be attained and are directly related to one's capacity to engage in physical activities. An essential correlation exists between the overall quantity of physical activity or exercise and the intensity at which it is conducted when determining the appropriate level of activity.2-4

Dose refers to the overall energy expenditure during physical activity, whereas intensity indicates the rate of energy expenditure during that activity. Intensity may be described in

absolute or relative terms. Absolute intensity refers to the rate at which energy is expended during physical activity and is often measured in metabolic equivalents (METs). One MET is comparable to the resting metabolic rate of about 3.5 milliliters of oxygen per kilogram of body weight per minute. Relative intensity is a measure of the amount of aerobic power used during exercise, represented as a percentage of either the maximum heart rate or the maximum oxygen consumption (V̇o2max). Moderate-intensity activities refer to physical activities that are conducted at a relative intensity of 40% to 60% of V̇o2max (or an absolute intensity of 4 to 6 METs). 5

Vigorous-intensity activities are exercises that are done at a level of effort that is more than 60% of the maximum rate at which the body uses oxygen (V̇o2max), or at an absolute intensity greater than 6 metabolic equivalents (METs). As an example, walking briskly at a speed of 4.8 km/h (equivalent to 3 miles/h) has an absolute intensity of around 4 METs. Relative to a 20-year-old healthy individual, this level of intensity is classified as light. However, for an 80-year-old person, it is deemed strong. 6

2. Preventing Atherosclerotic Vascular Disease

Over the last 50 years, research examining the relationship between physical activity at work and during free time have consistently shown that those who are more physically active and physically fit had a lower risk of developing coronary artery disease (CAD) events.7-9 Recent studies have corroborated these findings by using exercise capacity measurements, such as treadmill performance, as a gauge of regular physical activity. The findings meet the necessary requirements to establish a causal association based on epidemiological evidence. The results are robust, showing that those who are very physically active typically have half the rates of coronary artery disease compared to those who are the least physically active. The findings clearly show a correlation between lowering rates of coronary artery disease (CAD) and rising levels of physical exercise. 9,10

Several investigations were conducted in a prospective manner, which means they showed the correct order of events, since reduced levels of physical activity were seen before the development of CAD, rather than being a consequence of the illness itself.11,12 The findings align with previous research that has consistently shown reduced rates of coronary artery disease

(CAD) in those who are more physically active. However, it is important to note that in several individual investigations, the observed link did not approach statistical significance. Several investigations have shown that the occurrence of coronary artery disease (CAD) at a lower frequency was not influenced by other established risk factors for atherosclerosis. The findings are also credible and consistent with research showing the positive benefits of exercise on risk factors related to atherosclerosis, the functioning of the heart muscle, the size of coronary arteries, the ability to dilate blood vessels, the tone of blood vessels, and the susceptibility to ventricular fibrillation. Available data do not provide clear evidence that withdrawal of physical activity increases CAD risk, although results from the Harvard Alumni Study suggest that college athletic activity is not protective in later years without lifelong physical activity.13

Studies using the best designs and measurement instruments tend to show the strongest relationships between physical activity and decreased CAD events, probably because superior assessment techniques limit inaccuracies in categorizing physical activity levels.10 For example, studies on cardiorespiratory fitness, measured as treadmill performance times, and CAD show stronger associations than are seen in activity studies, probably because of the better classification by objective measures of fitness in comparison to the relatively imprecise assessments of self-reported physical activity.10 These epidemiological studies, combined with studies providing biological plausibility, provide conclusive evidence that physical activity reduces the incidence of CAD.

3. Decreasing Atherosclerotic Risk Factors

Engaging in physical exercise has the dual benefit of preventing and aiding in the treatment of certain well-established risk factors for atherosclerosis. These risk factors include high blood pressure, insulin resistance and glucose intolerance, high levels of triglycerides, low levels of high-density lipoprotein cholesterol (HDL-C), and obesity. Engaging in physical activity, together with losing weight, may lower levels of low-density lipoprotein cholesterol (LDL-C) and prevent the fall in high-density lipoprotein cholesterol (HDL-C) that often happens when saturated fat intake is reduced.14

The extent of the exercise impact is determined by the attributes of the exercise intervention, individual variability, and whether exercise leads to simultaneous decreases in body weight. The

impact on atherosclerotic risk factors might be significant in some people and eliminate the need for further therapies. Typically, exercise has a lesser impact on atherosclerotic risk factors compared to pharmaceutical treatments. However, when combined with other lifestyle modifications including changes in nutrition and weight reduction, the benefit of exercise may be dramatically enhanced.15

A comprehensive analysis of 52 exercise training trials lasting more than 12 weeks and involving 4700 participants revealed that on average, there was a 4.6% increase in HDL-C levels and a decrease of 3.7% and 5.0% in triglyceride and LDL-C concentrations, respectively. The most extensive and meticulously controlled exercise trial, known as the HEalth, RIsk factors, exercise Training, And GEnetics (HERITAGE) study, included 675 individuals with normal lipid levels who engaged in 5 months of exercise training. Among the 299 men studied, HDL-C levels increased by 1.1 mg/dL (3%), while triglycerides and LDL-C decreased by 5.9 and 0.9 mg/dL or 2.7% and 0.8%, respectively. The HDL-C levels in the group of 376 women showed an increase of 1.4 mg/dL (3%), whereas the triglycerides and LDL-C levels reduced by 0.6 and 4.4 mg/dL or 0.6% and 4%, respectively. Individuals with baseline hypertriglyceridemia may have greater increases in HDL-C. However, there is little research on the impact of exercise in persons with lipid problems.16-18

A total of 44 randomized controlled studies, including 2674 people, have examined the impact of exercise training on resting blood pressure. The average decrease in systolic and diastolic blood pressure was 3.4 and 2.4 mm Hg, respectively. The initial blood pressure level was a significant factor in determining the impact of exercise. The average systolic and diastolic blood pressures reduced by 2.6 and 1.8 mm Hg in normotensive individuals, and by 7.4 and 5.8 mm Hg in hypertensive individuals, respectively. These findings imply that exercise alone may be sufficient as a treatment for certain moderately hypertensive individuals. The study found no correlation between the frequency, duration, or intensity of exercise training and the extent of blood pressure drop. This indicates that the link between exercise and blood pressure follows a flat dose-response curve. 19,20

Engaging in physical activity has been shown to decrease insulin resistance and glucose intolerance, as well as postprandial hyperglycemia and potentially hepatic glucose output. A comprehensive analysis of 9 trials involving 337 individuals with type II diabetes revealed an

average decrease in hemoglobin (Hgb) A1c levels of 0.5% to 1% as a result of exercise training. It is important to note that these results may actually underestimate the true reduction in Hgb A1C due to the concurrent decrease in the use of diabetic medications. The Diabetes Prevention Program showcased the significant impact of physical activity and weight loss in preventing the development of type II diabetes in individuals at a high risk for this condition. In comparison to standard care, those who participated in a lifestyle intervention that resulted in an average weight loss of 4 kilograms and an increase of 8 metabolic equivalents of task hours per week experienced a 58% decrease in the occurrence of type II diabetes over a span of 2.8 years. The latter translates to an extra 593 kilocalories of energy expenditure every week or almost 6 kilometers of walking for a person weighing 70 kg. The lifestyle intervention had considerably greater efficacy compared to metformin (850 mg BID), resulting in a 31% reduction in the incidence of type II diabetes.18-20

Engaging in physical exercise is a crucial complement to a diet in order to accomplish and sustain weight reduction. The National Weight Control Registry conducted a study with a sample size of 3000 persons who achieved a weight reduction of more than 10% of their initial body weight and successfully maintained this weight loss for a minimum of 1 year. The participants, on average, dropped 30 kg and were able to sustain this weight loss for an average duration of 5.5 years. 81% of the participants indicated a rise in their level of physical exercise. Women and men reported burning 2445 and 3298 kcal respectively per week in activities such as walking, cycling, weight lifting, aerobics, jogging, and stair climbing. 21

A total of 8 studies have investigated the additional impact of exercise on quitting smoking. However, most of these trials were small in scale and the results were not analyzed collectively. In one larger trial, 281 healthy women were randomly assigned to either a 12-week behavior modification program combined with supervised vigorous exercise sessions three times a week, or an identical program with health education sessions three times a week. Among those who exercised, 19.4% were able to maintain continuous abstinence from smoking for at least 2 months by the end of the 12-week intervention, compared to 10.2% of the control group. After 12 months, 11.9% of the individuals who exercised and 5.4% of the individuals in the control group maintained continuous abstinence. These findings are early, but they indicate that

engaging in physical exercise may enhance long-term smoking cessation by boosting the rate at which individuals first stop smoking.21

The impact of physical activity on cardiovascular risk factors includes both immediate and short-term effects, which are not reliant on long-term exercise training or improvements in fitness. Vigorous exercise can lead to a reduction in serum triglycerides for up to 72 hours, as well as a temporary increase in HDL-C levels. Additionally, vigorous exercise can acutely lower systolic blood pressure, with this effect potentially lasting for up to 12 hours. Exercise also has positive immediate effects on glucose regulation. These immediate effects further support the recommendations from the CDC and the ACSM that adults should engage in moderate-intensity physical activity on most, if not all, days of the week.22

2. Conclusion

While there is enough data to support the promotion of higher levels of physical exercise among the general population and various patient groups, there are still certain elements of physical activity and its impact on health that need more research. The primary focus is on investigating behavioral methods and procedures that may effectively enhance physical activity levels in children and adolescents, while also ensuring that the increased activity is sustained throughout their lives. Adults need comparable knowledge about the elements that influence the adoption and continuation of physical exercise. Specifically, it is necessary to prioritize initiatives that promote physical activity via changes in organizational settings (such as workplaces and communities) and legislative policies, rather than only focusing on individual behavior. Furthermore, it is crucial to underline the significance of incremental change in physical activity behavior to ensure that patients do not see physical activity involvement as an all-or-none habit, similar to cigarette smoking. In the last ten years, significant knowledge has been acquired on the use of behavioral treatments to assist inactive individuals in increasing their physical activity levels, both in one-on-one and small-group settings. It is necessary to assess the effectiveness of spreading these treatments using contemporary technologies, such as the Internet. Further physiological and fundamental research is required to provide the scientific justification for the significance of physical exercise. Research in this field should focus on investigating the specific mechanisms through which exercise decreases the risk of coronary artery disease (CAD). Additionally, it should also study other medical disorders that may be

successfully addressed by exercise training. Further research is needed to examine the impact of physical inactivity on the current obesity crisis, as well as the effectiveness of physical exercise in treating obesity. It is crucial to gather data on the minimum and ideal levels of exercise and physical activity needed to get certain positive results, as well as to comprehend the individual variations that might enhance or hinder the advantageous impacts of physical training. Greater emphasis should be placed on evaluating the health advantages of physical exercise by considering the intensity in relation to an individual's fitness level, rather than as an absolute metric. Further research is required to evaluate the effectiveness of physical activity programs combined with modern treatment for patients with CAD. This is necessary since the existing data that forms the basis of our knowledge in this area is over a decade old, and the death rates for CAD have significantly decreased since then. Further research is required to investigate the potential hazards of physical activity, since the advantages of exercise for those with diagnosed or hidden coronary artery disease (CAD) may only be fully realized if the associated dangers are minimized. Ultimately, it is crucial to conduct cost-effectiveness studies in order to assess the impact of physical activity in comparison to other therapies on healthcare expenses.

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