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Effect of Physical Activity on Systemic Hypertension: A Review & Recommendations

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Abstract: Systemic hypertension is a major risk factor for cardiovascular diseases, and it is the most important but modifiable risk factor for all-cause morbidity and mortality worldwide. It is considered a complex and polygenic medical condition and influenced by genetic, environmental, and social determinants including unhealthy diet and lack of physical activity. Despite the available evidence strongly supporting the positive impact of physical activity in the prevention and treatment of hypertension in primary prevention, challenges remain to the medical and health care communities to incorporate this information into the daily practice of medicine. The purpose of this review is to investigate the effect of physical activity on systemic hypertension by presenting an update of the literature to strengthen current recommendations. Several search engines were reviewed, including PubMed, Medline, Cochrane Library, and Google Scholar using key words, hypertension, and physical activity. Populations under the age of eighteen were excluded from all nineteen reviewed studies. All the reviewed studies concluded that physical activity reduces blood pressure in men and women eighteen years of age and older. Physical activity is a recommended non-pharmacologic tool to treat hypertension. Currently, more than 75% of the US adult population does not meet the recommended physical activity guidelines. Consequently, primary care providers may collaborate with other professional health instructors to educate their patients about the current guidelines and recommendations regarding physical activity, and further discuss the effect of physical activity on hypertension.

Keywords: Hypertension, Physical Activity, Cardiovascular Disease, Blood Pressure, Randomized Clinical Trial

1. Introduction

Cardiovascular disease (CVD) is the major cause of morbidity and premature death worldwide. No longer is CVD a problem solely in wealthy countries; it has become a global concern [1]. Systemic Hypertension (HTN) is the most important but modifiable risk factor for all-cause morbidity and mortality worldwide and is associated with an increased risk of CVD causing at least 7.6 million deaths in the world every year [2, 3]. With the increase in the aging population, it is estimated that there will be 1.5 billion people with HTN globally by 2025 [2].

According to the Eighth Joint National Committee (JNC 8), HTN is defined as a chronic elevation of systolic blood pressure (SBP) >140 mmHg and/or diastolic blood pressure (DBP) >90 mmHg for individuals under 60 years of age, and 150/90 for individuals over 60 years of age [4]. HTN is classified as either primary (essential) or secondary HTN [5]. Approximately 95% of HTN cases are categorized as primary HTN, which lack any identifiable trigger for blood pressure (BP) rise. The remaining 5% of the cases are categorized as secondary HTN, which is caused by various medical conditions such as kidney disease etc. [5]. It has been estimated that more than 33% of Americans suffer from one or more types of CVD and HTN [6]. Among middle-aged adults, every 20-mmHg increase in SBP is associated with a

doubling in the rate of death resulting from stroke, ischemic heart disease, and other vascular causes [7].

HTN is a complex and polygenic medical condition with high prevalence among almost all populations; its etiology stems from combined genetic, environmental, and social determinants including obesity, unhealthy diet, excessive alcohol consumption, and lack of physical activity [8-10]. As a single risk factor, physical inactivity is believed to be responsible for 5-13% of HTN currently [10]. With direct and indirect costs amounting to $46.4 billion in 2011, and projections of six-fold increases by 2030, there is a need for low-cost non-pharmacological interventions [6]. Although anti-hypertensive medication remains the key treatment for HTN, there is strong evidence that physical activity reduces BP among all the adults with HTN [3, 11, 12]. It is well known that every 10-mmHg reduction in SBP significantly reduces the major CVD events including heart failure, stroke, and all-cause mortality [3]. According to research data, physical activity can improve total life expectancy and life expectancy free of CVD by 1.3 to 3.5 years [1].

As the global prevalence of HTN continues to rise and health care costs associated with HTN increase, it becomes important to invest in the prevention and management of HTN. Despite the available evidence, which strongly supports the positive impact of physical activity in the primary prevention and treatment of HTN, challenges remain to the medical and health care communities to incorporate this information into the daily practice of medicine. Further efforts to strengthen the non-pharmacological approach to help clarify practical guidelines are relevant. Indeed, the research question to be addressed is - What are the effects of physical activity on systemic HTN in adults? To answer this question, a review of recent literature was conducted to better understand the relationship between physical activity and HTN and provide a summary of the recommendations.

2. Methods

Multiple search engines were used including PubMed, Medline, Cochrane Library, and Google Scholar with key words including, HTN, physical activity, and the effect of physical activity on HTN. Originally, there were around 12,000 articles, which showed up under these search terms. Several filters were used to narrow the search with a time frame of the last five years, free full-text review articles with research in humans only, language English, and the age of the subjects eighteen and over, both men and women. Only nineteen most relevant articles were selected after carefully reading the abstracts of these articles, which involved the direct relationship of physical activity and HTN, making sure all the studies included were from either systematic review, meta-analysis, or randomized clinical trials (RCT).

3. Results

Oparil et al [2] reported that regular physical activity reduces BP in individuals with HTN. Endurance training reduces BP further in persons with HTN than in individuals with normal BP. A review of twenty-seven RCTs in individuals with HTN demonstrated that regular medium-intensity to high-intensity aerobic activity reduced BP by a mean of 11 mmHg SBP and 5 mmHg DBP [2]. Another review of three RCTs of isometric exercise showed a BP reduction of similar magnitude to that induced by aerobic exercise in individuals with HTN [2].

In a meta-analysis of fifteen RCTs, Pescatello et al [13] found strong evidence that low to vigorous-intensity physical activity reduced BP among adults with HTN compared to the control group who were physically inactive at baseline. According to this review of these fifteen RCTs, thirteen reported a statistically significant reduction in SBP and fourteen reported a reduction in DBP with an overall magnitude of the BP reductions ranging from 5-17 mmHg for SBP and 2-10 mmHg for DBP [13]. Five meta-analyses reported aerobic exercise training performed at moderate to vigorous intensity for forty minutes per session, three days a week for sixteen weeks, reduced SBP by 8.3 mm Hg (95% CI, -10.7 to -6.0), and DBP by 5.2 mmHg (95% CI, -6.9 to -3.4) [13]. Three meta-analyses reported that dynamic resistance training performed at moderate intensity for thirty-two minutes per session, three days per week for fourteen weeks, reduced SBP by 5.7 mmHg, and DBP by 5.2 mmHg [13].

Jin et al [3] reviewed a study of 1055 subjects using traditional Chinese exercise (TCE) combined with antihypertensive medication, vs antihypertensive medication by itself. They reported a reduction in SBP by 13.19 mmHg (95% CI, -16.30 to -10.08, $P<0.0001$) and DBP by 5.47 mmHg (95% CI, -7.76 to -3.18, $P<0.0001$) in the exercise group, compared to the control group with only antihypertensive medication [3]. Kazeminia et al [14] reported SBP changed from 137.8 +/- 1.09 mmHg to 132.08 +/- 0.96 mmHg, and DBP changed from 80.3 +/- 0.85 mmHg to 76.6 +/- 0.56 mmHg (95% CI), respectively, in individuals above 60 years of age who participated in moderate physical activity. Baghaiee et al [9] conducted a study by including 40 men with HTN divided into two groups, namely the exercise group (n=20) and the control group (n=20). The exercise group participated in aerobic exercise for twelve weeks. At the end of the period, there was a significant reduction in the exercise group for both SBP ($P=0.031$) and DBP ($P= 0.023$).

Samadian et al [10] reported in a meta-analysis that strength training can reduce both SBP and DBP by approximately 3-4 mmHg, but dynamic endurance training lowers BP by approximately 7 mmHg SBP and 5 mmHg DBP in hypertensive individuals. One study found that walking 36.5 minutes per session, 4.4 days per week for 19 weeks, reduced SBP by 5.2-11.0 mmHg and DBP by 3.8-7.7 mmHg. Whereas, cycling, three times per week, for 45 minutes per session for 16 weeks, in middle-aged men, reduced blood pressure by 12 mmHg SBP and 6.5 mmHg DBP compared to the control group by 3/1.1 mmHg (SBP/DBP) [10].

According to Samadian et al [10], six months of exercise

training produced lower DBP but no reduction in SBP in people aged fifty-five to seventy-five years of age, showing less benefit of physical activity to reduce BP in older individuals.

Sabbahi et al [6] reported the perseverance and enhancement of vascular function with improved vascular structure, reduced arterial stiffness and modulation, as well as normalization of the sympathetic nervous system (SNS) in patients with HTN through physical exercise over time. The study confirmed that exercise training leads to BP reduction through physiological effects including vascular and autonomic adaptations. On the contrary, physical activity yielded inconsistent results for arterial stiffness in elderly patients with HTN [6].

4. Discussion

Cardiovascular disease is the leading cause of death in the United States and the world, accounting for approximately 30% deaths in the United States and 31% globally. According to the Joint National Committee Seven (JNC 7), about 70% of Americans suffer from elevated BP or pre-HTN (SBP >120<140 mmHg, and DBP >80<90 mmHg), but 17.3% of those do not know that they have this condition [6, 13]. Only 50% of treated patients have their BP under control (6). If left untreated, 50% of HTN patients will die from coronary artery disease (CAD) and heart failure (HF), 33% percent due to stroke, and 10-15% due to kidney disease [14].

It is predicted that the prevalence of HTN will increase by more than 50% during the next thirty years, resulting in an enormous disease burden for society [5]. Despite the overwhelming evidence that HTN is a major treatable CVD risk factor, studies across the globe show that a large proportion of the population with HTN are either unaware of their elevated BP, or aware but not treated or inadequately treated [2]. Ten percent of the total hypertensive population of the world have resistant HTN (patients who take three or more antihypertensive medications from three or more different classes) [15]. It has been estimated that approximately 46,000 deaths among US adults can be prevented annually by controlling HTN [8].

The etiology of HTN involves the complex interplay of environmental and pathophysiological factors that affect multiple systems, as well as genetic predisposition. Vascular structural changes, endothelial dysfunction, and overstimulation of SNS are major contributing factors for HTN. There are numerous environmental factors that increase BP gradually over time including unhealthy diet, obesity, alcohol use, and physical inactivity [2, 6]. According to Wenger et al [16], physical inactivity is associated with a two-fold increase in cardiovascular disease risk.

Along with numerous pharmacological interventions, a variety of non-pharmacological interventions has been effective in the prevention and control of HTN. The most effective interventions are weight loss, a healthy diet, decreased intake of alcohol, and increased physical activity [2]. Assessment of the relationship between body weight and HTN has indicated that each ten-kilogram loss of weight markedly reduces the risk of HTN [9]. The underlying mechanisms regarding the benefits of physical activity include improvement in the skeletal musculature, myocardium, endothelial function in the vascular system, as well as decreases in inflammation, sympathetic nervous system stimulation, renin-angiotensin system activity, and total peripheral vascular resistance [1, 8].

Jin et al [3] reported in a systematic review that regular physical activity was beneficial for reducing mortality in patients with high BP. A systematic review of twenty-seven RCTs conducted in individuals with HTN revealed that regular medium-intensity to high-intensity aerobic activity reduced BP by a mean of 11/5 mmHg (SBP/DBP) [2]. Greater BP reductions occurred in individuals with higher resting BP in non-white individuals [2]. According to a meta-analysis, strength training can reduce systolic and diastolic BP by approximately 3-4 mmHg and dynamic endurance training lowers BP by 7/5 mmHg (SBP/DBP) in people with mild to moderate essential HTN [10]. Walking and cycling also proved to be effective physical activities to reduce BP [10]. According to Lin et al [17], studies have reported that eight weeks of aerobic physical activity reduced SBP and DBP in hypertensive postmenopausal women by approximately 3.8% and 5.9% respectively. Regular mild to moderate aerobic activity in women was associated with 5-8 mmHg overall BP reduction [17]. Another study [14] reported an improvement in left ventricle hypertrophy of patients with HTN, with a six-month aerobic exercise program. Kazeminia et al [14] reported a significant reduction in systolic and DBP in older adults in a meta-analysis showing a reduction of 137.8 +/- 1.09 and 132.08 +/- 0.96 for systolic and 80.3 +/- 0.85 and 76.6 +/- 0.56, respectively, for diastolic pre- and post-intervention. In people with resistant HTN who were taking three or more antihypertensive medications from different classes, treadmill walking three times per week for eight to twelve weeks improved SBP by 6 +/- 12 and DBP by 3 +/- 7 mmHg [15].

There have been multiple studies suggesting the efficacy of physical activity in the reduction of HTN, but the challenge is to verify the amount and the frequency of exercise that will produce the maximum health benefits at relatively low risk for injury. Carey et al [8] reported in a RCT that aerobic activity is best in reducing BP with 5-7 mmHg from the baseline, but dynamic and isometric resistance exercises are also effective, resulting in the benefit of 4-5 mmHg reduction. Samadian et al [10] reported that if the individual stops exercising, the BP returns to the same level as before exercising began, which can occur as quickly as within ten days depending on how long the individual exercised regularly. The JNC 8 Report has recommended physical activity as a lifestyle modification for lowering BP [3, 11]. Similarly, the Canadian Hypertension Education Program (CHEP) Guidelines in 2016, recommended 30-60 minutes of medium-intensity physical activity 4 to 7 times per week, in addition to regular daily activities for HTN patients [3]. Despite the well-known positive effect of

physical activity to lower BP, only about fifteen percent of US adults are meeting the recommended guidelines for physical activity [6].

The U.S. Department of Health and Human Services recommends adults to perform a minimum of 150 minutes of moderate or 75 minutes of vigorous physical activity weekly. In addition, it is recommended to engage in muscle-strengthening activities two or more days weekly. According to the Centers for Disease Control and Prevention, nationally, only about 53% of U.S. adults aged 18 years and older engaged in aerobic physical activity [18]. When considering both aerobic and muscle-strengthening activity, only about 23% of U.S. adults meet the recommended goal [18].

In Canada, approximately 50% of Canadian adults aged 18 to 79 meet the most recent recommended target of accumulating at least 150 minutes per week of moderate-to-vigorous intensity physical activity [19].

According to this review study, physical activity improves BP, and it should be part of the treatment plan as a non-pharmacologic tool to treat HTN. Multiple scientific studies around the globe have reported that physical activity improves BP throughout adult life, and it should be part of recommended non-pharmacologic tools to control HTN. Currently, only about 23% of the US adults meet the recommended physical activity guidelines [18]. Consequently, primary care providers (PCPs) should consider integrating this recommendation and discuss the importance when managing patients with HTN. However, PCPs may find it extremely challenging to find a way/time to measure physical activity of patients objectively and make personalized recommendations regarding the right amount of physical activity. Because of PCPs' busy schedules, other professional health instructors may collaborate with PCPs and measure patients' current lifestyles objectively and provide appropriate guidance to increase their physical activity as appropriate.

5. Conclusion

Physical activity is a recommended non-pharmacologic tool to treat HTN. Currently, more than 75% of the US adult population does not meet the recommended physical activity guidelines. Consequently, PCPs may collaborate with other professional health instructors to educate their patients about the current guidelines and recommendations regarding physical activity and further discuss the effect of physical activity on HTN. There is a need for additional research in the future about the physical activity dose effect for a specific age and sex group to achieve the maximum benefit at the lowest injury risk.

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