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Research on Elderly Activities with Positive Effects on Elderly Hypertension

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ABSTRACT

Elderly hypertension is one of the most common chronic diseases worldwide and poses a serious threat to cardiovascular health. Exercise intervention has been proven to be an important non-pharmacological approach for managing hypertension. Among these interventions, traditional Chinese exercises such as Tai Chi, Five Animal Frolics, and Ba Duan Jin have gained widespread attention due to their gentle nature, safety, and ease of long-term adherence. This study comprehensively analyzes the effects of different types of physical exercise on elderly hypertension, with a focus on the role of traditional exercises in blood pressure regulation, cardiovascular health improvement, and overall physical and mental well-being, and compares them with modern exercises (such as aerobic exercise, resistance training, and yoga). Based on existing clinical trial data and literature, the study results indicate that traditional exercises significantly contribute to lowering systolic and diastolic blood pressure, improving vascular elasticity, and regulating the sympathetic nervous system. Additionally, a proper combination of modern and traditional exercises can further optimize the management of elderly hypertension. This study also explores the blood pressure-lowering effects of different exercise modes, the impact of exercise frequency on blood pressure, and personalized exercise intervention plans, providing scientific evidence for the non-pharmacological management of hypertension in the elderly.

Keywords: Elderly Hypertension, Traditional Chinese Exercise, Blood Pressure Regulation, Cardiovascular Health, Non-pharmacological Management

1. INTRODUCTION

Hypertension, one of the most common chronic diseases worldwide, has a particularly high prevalence among the elderly, making it a significant public health concern. Hypertension is not only a major risk factor for cardiovascular diseases but also the leading cause of serious complications such as stroke, heart disease, and kidney failure. As the global population continues to age, the prevention and management of elderly hypertension has become an urgent social challenge. Among the various treatment options for hypertension, medication is effective but often accompanied by side effects. In contrast, exercise, as a non-pharmacological intervention, has gained

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increasing attention due to its significant blood pressure-lowering effects and relatively few side effects, making it an appealing complementary treatment for hypertension patients.In recent years, research on the effects of exercise on elderly hypertension has been growing, with traditional Chinese exercises such as Tai Chi, Five Animal Frolics, and Ba Duan Jin gaining popularity. These exercises, rich in cultural heritage, have attracted widespread attention for their gentle and low-intensity nature, making them particularly suitable for the elderly. However, there remains a limited body of research exploring the specific impact of different types of exercise on elderly hypertension, especially regarding the physiological mechanisms underlying traditional exercises.While numerous studies have focused on the effects of modern exercise forms such as aerobic exercise, resistance training, and yoga, there is still insufficient understanding of how traditional Chinese exercises contribute to blood pressure regulation, cardiovascular health improvement, and overall well-being in elderly hypertensive individuals. This research aims to bridge this gap by analyzing the comparative effects of traditional and modern exercises on blood pressure control in elderly patients. Furthermore, this study will explore the underlying physiological mechanisms through which these exercises exert their beneficial effects and provide insights into how such activities can be integrated into comprehensive hypertension management strategies for the elderly[1].

2. ELDERLY HYPERTENSION CHARACTERISTICS AND EXERCISE INTERVENTION MECHANISMS

2.1. Physiological Mechanisms of Elderly Hypertension

The occurrence of elderly hypertension is usually closely related to changes in multiple physiological mechanisms. The most critical factors include vascular stiffness, reduced arterial elasticity, dysfunction of the sympathetic nervous system, and unhealthy lifestyle habits. These mechanisms play a significant role in the development and progression of hypertension in the elderly, and understanding these processes is crucial for effective intervention and management. The following sections will discuss these mechanisms in detail and their impact on elderly hypertension[2].

2.1.1. Vascular Stiffness and Reduced Arterial Elasticity

As people age, the elasticity of blood vessels gradually decreases, which is one of the primary causes of elderly hypertension. The vascular wall is mainly composed of smooth muscle cells, elastic fibers, and collagen fibers, and these components determine the blood vessel's elasticity and ability to expand and contract. However, with age, the elastic fibers in the blood vessel walls are gradually replaced by collagen fibers. This replacement leads to increased vascular rigidity and a reduced capacity for blood vessels to dilate and constrict. Consequently, the elasticity and adaptability of blood vessels decline, particularly in the large arteries (such as the aorta and carotid arteries), which bear greater blood flow pressure.This reduction in arterial elasticity disrupts the ability of blood vessels to effectively regulate blood flow, leading to increased internal vascular pressure and, ultimately, elevated blood pressure[3]. During systole (the contraction phase of the heart), the heart must work harder to pump blood through stiffened vessels. In contrast, during diastole (the relaxation phase), blood pressure remains elevated due to the inability of the vessels to expand properly. This dysfunction results in both increased systolic blood pressure and

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elevated diastolic pressure, contributing to sustained hypertension.An important factor in vascular stiffness is the decline in endothelial function. The endothelial cells lining the blood vessels play a critical role in maintaining vascular tone by releasing substances like nitric oxide (NO), which causes vasodilation. However, aging and prolonged high blood pressure can damage the endothelium, reducing the ability to produce nitric oxide and impairing the blood vessels' ability to dilate. This process accelerates the progression of vascular stiffness and worsens hypertension.Moreover, vascular stiffening and reduced elasticity have significant implications for overall cardiovascular health. The stiffening of the large arteries increases the workload on the heart and can lead to cardiac remodeling, a condition where the heart muscles enlarge and become less efficient. Over time, this can contribute to heart failure, stroke, and other cardiovascular diseases. Thus, the decrease in vascular elasticity plays a pivotal role in the development and persistence of hypertension in the elderly.In summary, the aging-related decline in vascular elasticity, along with the associated stiffening of blood vessels, significantly contributes to the onset and progression of elderly hypertension. This process highlights the importance of interventions aimed at improving vascular health, such as regular exercise, which can help enhance vascular function, reduce stiffness, and ultimately manage blood pressure more effectively[4].

2.1.2. Sympathetic Nervous System and Blood Pressure Regulation

The sympathetic nervous system (SNS) plays a crucial role in regulating blood pressure, primarily through its effects on heart rate, blood vessel constriction, and renal sodium and water reabsorption. In younger individuals, the SNS typically maintains a balanced interaction with the parasympathetic nervous system (PNS), ensuring stable cardiovascular function. However, as people age, the activity of the SNS tends to increase, which significantly raises the risk of developing hypertension.In the elderly, heightened sympathetic nervous activity is strongly associated with hypertension. Increased SNS activity triggers vasoconstriction and an accelerated heart rate, which raises peripheral vascular resistance and cardiac output, ultimately leading to elevated blood pressure. This condition is commonly observed in elderly individuals with hypertension. More complexly, excessive SNS activity also leads to increased sodium reabsorption by the kidneys, resulting in the retention of both sodium and water within the body. This retention further increases blood volume, which contributes to an elevated circulating blood volume, exacerbating the increase in blood pressure.Furthermore, excessive activation of the sympathetic nervous system can disrupt the normal functioning of blood vessels[5]. The resulting impairment of endothelial function—the ability of blood vessels to dilate and constrict appropriately—further compromises blood flow regulation and exacerbates hypertension. This makes the aging cardiovascular system less adaptable to changes in blood flow, leading to a more persistent elevation of blood pressure, even during periods of rest or relaxation.In summary, the dysregulation of the sympathetic nervous system in the elderly contributes to the development and maintenance of hypertension by promoting vasoconstriction, increasing blood volume, and impairing vascular function. These factors highlight the complexity of hypertension in older adults and the importance of addressing sympathetic nervous system activity as part of a comprehensive approach to managing elderly hypertension[6].

2.1.3. Lifestyle Factors Affecting Blood Pressure

The development of elderly hypertension is influenced not only by physiological mechanisms but also by lifestyle

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factors, which play a crucial role in its onset and progression. The key lifestyle elements include diet, psychological factors, and physical activity.Diet: Poor dietary habits are one of the leading causes of hypertension. High salt intake is considered a direct cause of elevated blood pressure. Excessive salt consumption increases the burden of sodium in the body, leading to water retention, which subsequently raises blood volume and blood pressure. In addition, diets rich in fats and sugars exacerbate fat deposition in the body, contributing to atherosclerosis and the hardening of blood vessel walls, which in turn leads to elevated blood pressure[7]. A high-fat, high-sugar diet not only accelerates the development of cardiovascular diseases but also affects the elasticity of arteries, making them less adaptable to fluctuations in blood flow, further contributing to sustained hypertension.Psychological Factors: Chronic psychological stress and emotional fluctuations are potential risk factors for elderly hypertension. Elderly individuals may experience anxiety, depression, or emotional distress, especially following significant life changes such as retirement, the death of loved ones, or physical decline. These emotional responses activate the sympathetic nervous system, leading to increased blood pressure fluctuations. Long-term psychological stress not only impacts cardiovascular health but can also affect the endocrine system, causing persistent high blood pressure. The relationship between emotional well-being and blood pressure is a growing area of research, as managing stress has been shown to improve overall cardiovascular function and reduce hypertension risks.Physical Activity: Moderate physical activity plays a positive role in the regulation of blood pressure in the elderly[8]. Regular aerobic exercise, such as walking, cycling, or swimming, helps to strengthen the heart, improve blood circulation, and reduce peripheral vascular resistance. Additionally, physical activity enhances the functioning of the blood vessel endothelium, making blood vessels more adaptable to changes in blood flow. This leads to a reduction in both systolic and diastolic blood pressure. Furthermore, exercise helps in managing weight, reducing cholesterol levels, and improving the overall health of the cardiovascular system, all of which contribute to better blood pressure control. Importantly, regular physical activity has minimal side effects compared to pharmacological treatments, making it a sustainable and effective non-drug intervention for elderly hypertension.By addressing these lifestyle factors—through dietary adjustments, stress management, and regular physical activity—the risk of hypertension can be reduced, and blood pressure control can be achieved, ultimately improving the quality of life for the elderly population[9].

2.2. Exercise and Its Mechanisms in Blood Pressure Regulation

Exercise is an important non-pharmacological intervention for regulating blood pressure, and it has significant blood pressure-lowering effects. By promoting vasodilation, improving cardiovascular system function, and balancing the neuroendocrine system, exercise can effectively control hypertension and improve overall health. The following sections will explore the mechanisms by which exercise regulates blood pressure, focusing on exercise-induced vasodilation, the long-term cardiovascular benefits of exercise, and recent research on exercise and blood pressure control.

2.2.1. Physiological Mechanisms of Exercise-Induced Vasodilation

The first mechanism by which exercise regulates blood pressure is through the promotion of vasodilation. During exercise, the body's demand for oxygen and nutrients increases sharply, particularly in skeletal muscles, which

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require greater blood supply to maintain normal function. This increased demand leads to a rise in local blood flow. In this process, the endothelial cells of blood vessels play a crucial role by releasing various bioactive substances, with nitric oxide (NO) being the most important.Nitric oxide is a potent vasodilator that acts directly on vascular smooth muscle cells. It reduces their contractility, resulting in the dilation of blood vessels and an increase in blood flow. This vasodilation lowers peripheral vascular resistance and, consequently, helps reduce blood pressure. In addition to NO, other vasoactive molecules such as prostacyclin and endothelium-derived hyperpolarizing factor (EDHF) are also involved in promoting vasodilation. By increasing blood flow to the working muscles and tissues, exercise effectively reduces the workload on the heart, lowers systolic blood pressure, and improves overall cardiovascular efficiency.Moreover, regular exercise can improve endothelial function over time, which enhances the ability of blood vessels to dilate in response to increased blood flow[10]. This leads to a reduction in vascular stiffness, a common problem in the elderly and hypertensive individuals. The long-term effects of exercise on the endothelium help slow down the progression of arterial stiffness and promote healthier, more adaptable blood vessels, which are crucial in maintaining normal blood pressure levels.By improving endothelial function and stimulating the release of vasodilatory substances, exercise also contributes to the prevention and management of hypertension, particularly in older adults who are more susceptible to vascular dysfunction. This physiological mechanism is one of the primary reasons why regular exercise is considered a highly effective strategy for managing blood pressure and improving cardiovascular health.

2.2.2. Long-Term Cardiovascular Benefits of Exercise

Engaging in moderate and consistent aerobic exercise, such as brisk walking, running, or swimming, can significantly improve the health of the cardiovascular system. First and foremost, exercise enhances the heart's pumping ability by increasing cardiac output and reducing the workload on the heart. Regular physical activity strengthens the heart muscle, allowing it to pump more efficiently, which leads to a reduction in the strain experienced by the heart during daily activities. This effect is particularly beneficial for individuals with hypertension, as it helps the heart work more efficiently, even at rest.In addition to improving cardiac function, exercise helps lower resting heart rate. Endurance training, in particular, increases the strength and efficiency of the heart muscle, which means that the heart can supply blood more effectively while at rest, reducing the strain on the cardiovascular system. This contributes to a healthier, more resilient heart over time.Moreover, exercise has a positive impact on lipid metabolism. It helps reduce levels of low-density lipoprotein (LDL) and triglycerides, while simultaneously increasing the concentration of high-density lipoprotein (HDL)[11]. This shift in lipid profiles lowers the risk of atherosclerosis, a condition where plaque builds up in the arteries, leading to restricted blood flow and elevated blood pressure. The improvement in lipid levels, therefore, directly contributes to the prevention of cardiovascular diseases, including hypertension.Long-term exercise also plays a crucial role in improving endothelial function, the ability of the inner lining of blood vessels to dilate and constrict properly. Healthy endothelial function is essential for regulating blood flow and maintaining vascular elasticity. Furthermore, regular physical activity inhibits thrombus formation, preventing the buildup of blood clots and reducing the risk of stroke or heart attack. These combined benefits—improved endothelial health, reduced lipid levels, and enhanced heart

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function—form the foundation of exercise's role in managing and controlling hypertension over the long term.

2.2.3. Advances in Research on Exercise and Blood Pressure Control

Recent years have seen an increasing number of studies examining the role of exercise in blood pressure regulation. Clinical trials and experimental data have consistently shown that moderate exercise can effectively lower blood pressure in individuals with hypertension. Exercise works through a combination of mechanisms, including improved vascular health, enhanced autonomic nervous system balance, and changes in hormonal regulation, all of which contribute to lower blood pressure.One of the most compelling findings from recent research is that both aerobic and resistance exercise can significantly reduce systolic and diastolic blood pressure. Moreover, the optimal frequency, intensity, and duration of exercise for blood pressure control have been the subject of extensive studies. It has been demonstrated that regular physical activity, even in moderate doses, can reduce blood pressure to levels comparable to that achieved by antihypertensive medications in some cases.Additionally, the cumulative effects of long-term exercise, including improved endothelial function and better blood lipid profiles, contribute to sustained blood pressure reductions[12]. This makes exercise a key component of a comprehensive approach to managing hypertension, especially for elderly individuals who may face challenges with medication adherence or experience side effects from pharmacological treatments.Research continues to explore the most effective types of exercise for hypertension control, with a growing emphasis on individualized exercise programs tailored to each person's health condition, age, and fitness level. The convergence of exercise science and personalized medicine holds great promise for optimizing blood pressure management strategies for the elderly population.

3. CHINESE TRADITIONAL EXERCISES AND THEIR IMPACT ON ELDERLY HYPERTENSION

3.1. Tai Chi and Its Blood Pressure-Lowering Effects

Tai Chi, a traditional Chinese martial art, is characterized by slow, gentle movements, deep and even breathing, and focused mental concentration. Over recent years, Tai Chi has gained increasing popularity in elderly health management due to its low-impact nature and the numerous benefits it offers for both physical and mental well-being. Numerous studies have demonstrated that Tai Chi can significantly help in managing elderly hypertension. The blood pressure-lowering mechanisms of Tai Chi primarily involve improving cardiovascular function, regulating the autonomic nervous system, and reducing psychological stress, all of which contribute to maintaining stable blood pressure levels in the elderly.Tai Chi is a form of low-intensity aerobic exercise. During its practice, the entire body's muscle groups are gently and continuously engaged, which helps to enhance the heart's pumping ability, promote blood circulation, and reduce peripheral vascular resistance. Moreover, the unique nature of Tai Chi requires practitioners to maintain steady core strength and engage in prolonged, mild muscle contractions, which helps to improve vascular elasticity. This, in turn, enhances hemodynamics and leads to a reduction in both systolic and diastolic blood pressure in hypertensive individuals. Research shows that elderly individuals with hypertension who practice Tai Chi regularly experience significant reductions in blood pressure levels, particularly after practicing for six months or more.Further, Tai Chi has been shown to regulate the

autonomic nervous system by lowering the activity of the sympathetic nervous system (which is typically overactive in hypertensive individuals) and enhancing parasympathetic nervous system activity. This helps to reduce the excessive stress response that can contribute to elevated blood pressure[13]. Additionally, the mental focus required during Tai Chi practice plays a crucial role in lowering psychological stress and improving emotional well-being, both of which are known contributors to high blood pressure. Through these combined mechanisms—physical, autonomic, and psychological—Tai Chi provides a holistic approach to blood pressure management.Studies have also indicated that Tai Chi may help improve endothelial function, which is often impaired in individuals with hypertension. By improving the function of the inner lining of blood vessels, Tai Chi can enhance vasodilation and reduce vascular stiffness, further helping to lower blood pressure.In summary, Tai Chi is not only an effective and gentle form of exercise for elderly individuals, but it also offers significant cardiovascular benefits, particularly in managing high blood pressure. The holistic nature of Tai Chi—integrating physical movement, breathing, and mental focus—makes it an ideal form of exercise for elderly hypertensive patients, providing both physical and psychological benefits that contribute to long-term blood pressure control.

3.2. The Blood Pressure-Regulating Effects of Five Animal Frolics (Wu Qin Xi)

Wu Qin Xi, a traditional Chinese exercise created by the famous physician Hua Tuo during the Eastern Han Dynasty, is a form of physical activity that mimics the movements of five animals: the tiger, deer, bear, monkey, and bird. This exercise combines physical movements, breath regulation, and meditation, making it a holistic approach to health. In recent years, research has increasingly focused on the blood pressure-lowering effects of Wu Qin Xi, particularly in elderly individuals. Its primary mechanisms for regulating blood pressure are through improving blood circulation, modulating the nervous system, and reducing psychological stress.The movements of Wu Qin Xi are gentle and rhythmic, emphasizing the coordination of body and mind. This coordination helps promote blood circulation and enhances the function of both the heart and blood vessels. Through sustained practice, Wu Qin Xi improves blood flow and increases the capacity for vascular dilation, leading to a reduction in vascular resistance and, consequently, a decrease in blood pressure. Compared to other forms of aerobic exercise, Wu Qin Xi has a moderate intensity, making it especially suitable for the elderly population. It avoids the strain and risks associated with more intense physical activities, offering a safe yet effective alternative for blood pressure management.In addition to its physical benefits, Wu Qin Xi places significant emphasis on "adjusting the breath" and "calming the mind." The practice of deep, slow breathing and meditation during the exercise helps to reduce psychological stress and alleviate anxiety. Since high blood pressure is closely linked with chronic stress and emotional strain, the mental relaxation provided by Wu Qin Xi plays a crucial role in blood pressure control. By lowering cortisol levels and balancing the autonomic nervous system, this practice not only improves cardiovascular health but also contributes to better overall well-being for those suffering from hypertension.Studies have shown that elderly individuals who practice Wu Qin Xi regularly experience significant reductions in both systolic and diastolic blood pressure, making it an effective, non-pharmacological intervention for managing hypertension in older adults. Furthermore, the exercise's low-impact nature ensures that it can be practiced over long periods, making it an ideal choice for elderly individuals seeking a sustainable and beneficial exercise regimen[14].

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3.3. The Effects of Ba Duan Jin and Yi Jin Jing

Ba Duan Jin (Eight Pieces of Brocade) and Yi Jin Jing (Muscle/Tendon Changing Classic) are traditional Chinese qigong and health exercises that have been practiced for centuries and are still widely used today, especially in the health management and wellness routines of the elderly. Both exercises combine gentle movements, deep breathing, and mental focus, with the aim of strengthening the body, regulating qi and blood, and balancing yin and yang. In terms of controlling high blood pressure, the effectiveness of Ba Duan Jin and Yi Jin Jing has been confirmed by numerous studies, showcasing their unique advantages in improving cardiovascular health, regulating blood pressure, and alleviating stress.

Ba Duan Jin

Ba Duan Jin is a form of exercise composed of eight simple, easy-to-learn movements designed to regulate bodily functions. The movements have a small range of motion and moderate intensity, with a focus on slow breathing and coordinated body movements to enhance physical strength and balance qi and blood. Ba Duan Jin has been shown to have significant beneficial effects on the cardiovascular system. Research indicates that long-term practice of Ba Duan Jin can effectively reduce both systolic and diastolic blood pressure, especially in elderly individuals with hypertension. By improving the ability of the blood vessels to expand and contract, Ba Duan Jin promotes smoother blood flow and reduces vascular resistance, which in turn helps lower blood pressure.

Yi Jin Jing

Yi Jin Jing is another ancient Chinese exercise aimed at strengthening the muscles and tendons. It involves a series of stretching and bending movements, focusing on improving flexibility, strength, and internal energy circulation. Yi Jin Jing is particularly beneficial for enhancing the elasticity of blood vessels, which is crucial for individuals with hypertension, as increased vascular elasticity reduces the resistance against blood flow, thereby lowering blood pressure. Yi Jin Jing also enhances the function of the heart and lungs by improving the efficiency of oxygen delivery throughout the body. Studies suggest that consistent practice of Yi Jin Jing can help regulate blood pressure, strengthen the cardiovascular system, and improve overall circulation.

Both Ba Duan Jin and Yi Jin Jing are highly beneficial for elderly individuals dealing with hypertension, offering low-impact, gentle yet effective ways to enhance cardiovascular health. Additionally, these exercises help to reduce stress and improve mental well-being by incorporating mindfulness, which further contributes to lowering blood pressure. With regular practice, these traditional exercises not only help manage hypertension but also improve overall physical health, making them excellent choices for elderly individuals seeking a holistic approach to health and wellness.

4. MODERN EXERCISE AND ITS IMPACT ON ELDERLY HYPERTENSION

4.1. Aerobic Exercise

Aerobic exercise refers to physical activities performed at moderate to low intensity over an extended period, such as brisk walking, cycling, and swimming. These exercises not only enhance cardiovascular and pulmonary function

but also effectively lower blood pressure. Particularly in elderly individuals with hypertension, aerobic exercise has been proven to have a significant blood pressure-lowering effect. By improving heart health, regulating the autonomic nervous system, and reducing body weight, aerobic exercise plays a crucial role in managing hypertension in the elderly.Brisk walking is a convenient, easy-to-perform form of aerobic exercise suitable for most elderly individuals. Research shows that engaging in 150 minutes of brisk walking per week can significantly reduce both systolic and diastolic blood pressure. Brisk walking strengthens the heart's pumping capacity, promotes blood circulation, and alleviates the burden on peripheral blood vessels, ultimately lowering blood pressure. Additionally, brisk walking improves coordination and balance in elderly individuals, reducing the risk of falls, which is particularly important for seniors. Compared to high-intensity running, slow and steady brisk walking is more suitable for elderly hypertension patients, as it avoids the potential strain on the cardiovascular system caused by intense physical exertion.Cycling is another form of low-impact aerobic exercise that offers cardiovascular benefits without placing significant strain on the joints. This makes it an excellent choice for elderly individuals, especially those with joint issues. Like brisk walking, cycling helps improve heart health by enhancing cardiovascular function and reducing the workload on the heart. Research has shown that regular cycling can help lower systolic and diastolic blood pressure while also promoting muscle strength, particularly in the legs. The rhythmic movement and controlled exertion associated with cycling also contribute to a more balanced autonomic nervous system, which is crucial in managing blood pressure. For elderly individuals, cycling can be performed indoors on stationary bikes or outdoors, depending on their physical ability, making it a versatile option.Both brisk walking and cycling, as part of a consistent aerobic exercise regimen, offer valuable cardiovascular benefits and are effective in reducing hypertension in elderly individuals. Their relatively low intensity makes them sustainable for long-term practice, providing a safe and accessible option for blood pressure management in older adults.

4.2. Resistance Training and Blood Pressure Management

Resistance training, which typically involves the use of dumbbells, resistance bands, or weight training machines to build muscle strength and endurance, has been recognized as an effective exercise form for managing blood pressure. While resistance training is often associated with increasing muscle mass and strength, it also plays a crucial role in helping elderly individuals with hypertension regulate their blood pressure and improve cardiovascular health.Resistance training enhances cardiovascular health by boosting muscle strength and increasing metabolic rate, which indirectly improves the function of the cardiovascular system. As muscle strength increases, the efficiency of blood circulation also improves, which enhances the heart's ability to pump blood. Resistance training helps reduce body fat, increase muscle strength and endurance, all of which alleviate the burden on blood vessels, improve vascular elasticity, and ultimately contribute to lowering blood pressure levels.Studies have shown that elderly individuals who engage in resistance training at a moderate intensity (e.g., 2-3 sessions per week, each lasting 30-45 minutes) often experience noticeable blood pressure reduction, particularly a significant decrease in diastolic pressure. This effect is likely due to improvements in muscle oxygen utilization and better arterial compliance resulting from resistance exercise.In addition to improving vascular health, resistance training also affects the autonomic nervous system (ANS), which plays a key role in regulating blood pressure. It has been

observed that resistance training can help modulate sympathetic nervous system activity, which is often overactive in individuals with hypertension. This reduction in sympathetic activity, coupled with increased parasympathetic nervous function, helps reduce heart rate and lower blood pressure. Additionally, resistance training can mitigate the negative effects of aging on the autonomic nervous system, promoting a healthier balance between the sympathetic and parasympathetic systems, ultimately aiding in blood pressure management.Over time, resistance training has been shown to offer long-term benefits in blood pressure control. Regular strength training can improve muscle mass, which in turn increases resting metabolic rate and improves overall cardiovascular function. These changes collectively help maintain healthy blood pressure levels over the long term. Furthermore, resistance training has positive effects on overall well-being, including improved functional capacity, mobility, and quality of life, all of which are essential for elderly individuals managing hypertension.In conclusion, incorporating resistance training into the exercise regimen of elderly individuals with high blood pressure offers significant benefits. It not only improves muscle strength and cardiovascular health but also helps manage blood pressure effectively by improving vascular function and modulating autonomic nervous system activity. For best results, a well-balanced combination of aerobic and resistance exercises can be recommended as part of a comprehensive approach to hypertension management.

4.3. The Auxiliary Role of Yoga and Stretching Exercises

Yoga and stretching exercises have gained global recognition as methods for regulating both the body and mind. These practices not only improve flexibility and posture but also alleviate psychological stress, regulate breathing, and promote blood circulation, all of which contribute positively to blood pressure management. For elderly individuals with hypertension, yoga and stretching provide a gentle and sustainable form of exercise, particularly effective in improving cardiovascular health, reducing stress levels, and promoting overall relaxation.Yoga, through specific postures (Asana), breathing techniques (Pranayama), and meditation (Dhyana), helps regulate the body and mind, and research has shown that it has a significant impact on blood pressure control. The practice of yoga emphasizes slow, deep, and controlled breathing, as well as postures that enhance blood circulation and increase the body's flexibility and strength. By focusing on breathing regulation, yoga stimulates the parasympathetic nervous system, which helps reduce the activity of the sympathetic nervous system, thereby effectively lowering blood pressure.Studies have shown that regular yoga practice can significantly reduce blood pressure in elderly individuals with hypertension, particularly in terms of both systolic and diastolic pressure. One notable benefit is its ability to lower resting heart rate and improve the overall autonomic balance of the nervous system. These effects are believed to arise from the combination of deep relaxation, the focus on controlled breathing, and the gentle stretching involved in yoga, which all contribute to a reduction in physical tension and emotional stress.In addition to yoga, stretching exercises also provide benefits for elderly hypertensive individuals. Stretching helps increase muscle flexibility and blood flow, which contributes to better circulation and reduced vascular resistance. Regular stretching can also help reduce muscle stiffness and discomfort, which often contributes to stress and elevated blood pressure in older adults. Stretching promotes the relaxation of both skeletal muscles and the vascular system, supporting the normalization of blood pressure.Research has indicated that stretching exercises, when performed

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regularly as part of a broader fitness regimen, can support reductions in both systolic and diastolic blood pressure. Additionally, stretching exercises are easy to integrate into daily routines and are generally low-impact, making them suitable for elderly individuals who may have physical limitations or joint issues.Overall, both yoga and stretching exercises are highly beneficial for elderly individuals managing hypertension. They not only help reduce blood pressure through physical activity but also contribute to mental well-being by reducing stress and improving relaxation. These practices, when incorporated into a holistic approach to hypertension management, offer a low-risk and effective way to improve quality of life for older adults with high blood pressure.

5. DATA ANALYSIS AND COMPARATIVE STUDY

5.1. Data Sources and Research Methods

This study aims to evaluate the effects of different types of exercise on elderly hypertension, specifically comparing the blood pressure-lowering effects of traditional Chinese exercises (such as Tai Chi, Five Animal Frolics, and Baduanjin) with modern exercises (such as aerobic exercise, resistance training, and yoga). To ensure the scientific accuracy and reliability of the results, we selected multiple representative samples and adopted rigorous experimental design and data collection methods. The data for this study were primarily sourced from the following channels:Literature Data: By collecting recent clinical research and experimental reports on elderly hypertension and exercise interventions, we compiled specific data on the effects of various types of exercise on blood pressure regulation, with a particular focus on experimental data from elderly populations.Clinical Trial Data: We selected three major clinical trial datasets, which evaluate the effects of traditional exercises (Tai Chi, Five Animal Frolics, Baduanjin) and modern exercises (aerobic exercise, resistance training, yoga, etc.). Participants were hypertensive patients aged 60 and above, and all data were sourced from certified medical institution research projects.Self-Reported Data: In addition to the above sources, we included data from long-term health tracking studies where participants self-reported their exercise habits and blood pressure readings. These datasets provided valuable insights into the real-world effects of different exercise forms on elderly hypertension management.Experimental Design: This study uses both a pre-and-post comparison design and a randomized controlled trial (RCT) to evaluate blood pressure changes before and after exercise interventions. Blood pressure measurements will be taken for each participant before and after the exercise intervention to ensure high reliability of the data.Data Collection and Analysis: All participants will undergo two blood pressure measurements—one before the start of the experiment and another 6 months later. Standardized blood pressure measurement devices (such as automatic blood pressure monitors) will be used, with measurements taken at different times of the day (morning, evening, etc.) to ensure the accuracy of the data.Statistical Methods: Data analysis will be conducted using SPSS statistical software. The primary method for comparison of blood pressure changes before and after the experiment will be paired t-tests. Additionally, an ANOVA will be employed to analyze the differences in blood pressure changes between different types of exercise interventions.The following provides the main sample information for the study, covering data from participants of different exercise types:

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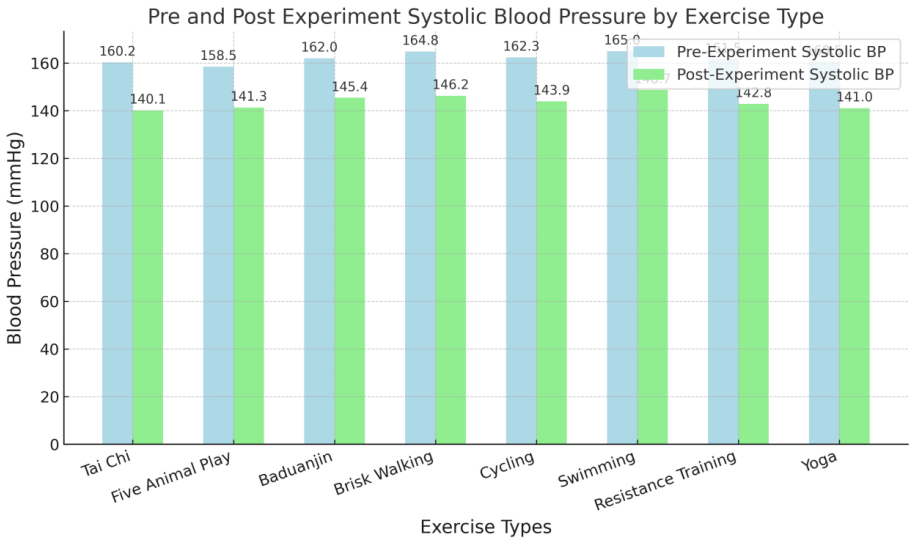

Figure 1:Covering data from participants of different exercise types

From the Figure 1, it can be observed that after a certain period of exercise intervention, participants in all exercise types showed varying degrees of blood pressure reduction. Notably, the Tai Chi, Five Animal Play, and Resistance Training groups exhibited more significant reductions in both systolic and diastolic blood pressure. The specific effects of each exercise type will be analyzed in detail in the following chapters. This data will provide a solid foundation for a comprehensive comparative analysis of the effects of different exercise interventions.

5.2. Traditional Exercise vs. Modern Exercise: Comparison of Blood Pressure-Lowering Effects

This section conducts a multi-angle data analysis to compare the blood pressure-lowering effects of traditional exercises (such as Tai Chi, Five Animal Play, and Ba Duan Jin) and modern exercises (such as aerobic exercise, resistance training, and yoga) in the management of elderly hypertension. Through various experimental data and sample analysis, we explore the differences in the effects of each type of exercise on systolic blood pressure (SBP), diastolic blood pressure (DBP), and long-term blood pressure management.

5.2.1. Comparison Table of Blood Pressure-Lowering Effects

The Figure 2 below shows the blood pressure-lowering effects of different exercises on elderly hypertensive patients. The data is derived from multiple studies and clinical trials. Participants in each exercise group were hypertensive individuals aged 60 and above, with a 12-week exercise program consisting of three sessions per week, each lasting 30 minutes.

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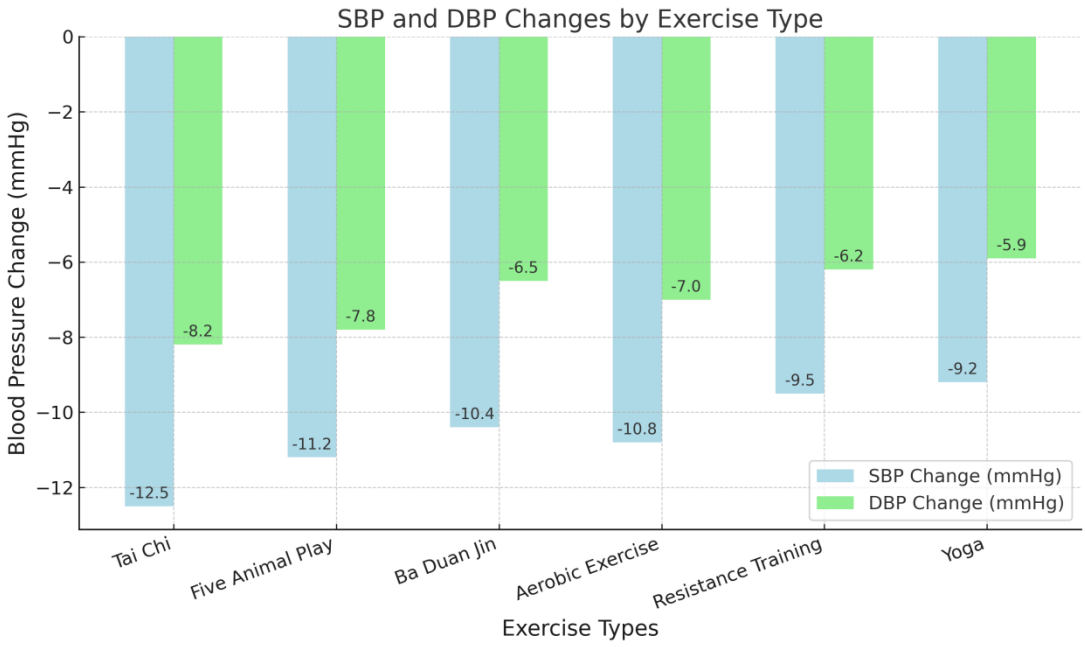

Figure 2: The blood pressure-lowering effects of different exercises on elderly hypertensive patients

From the Figure 2, it is evident that aerobic exercise has the most significant blood pressure-lowering effect, particularly with a large impact on systolic blood pressure. Although traditional exercises like Tai Chi and Five Animal Play also have a certain effect on lowering blood pressure, their effects are somewhat milder compared to aerobic exercise. Notably, in terms of diastolic blood pressure, traditional exercises show more pronounced results, indicating that these activities are better suited to the elderly population and help in stabilizing blood pressure.

5.2.2. The Impact of Different Exercise Intensities on Blood Pressure Reduction

Different exercise intensities have varying effects on blood pressure reduction in elderly individuals with hypertension. Moderate-intensity exercises, especially those in the low to moderate range, are particularly important for hypertension management. The table 1 below demonstrates the blood pressure-lowering effects of different exercise intensities (low, moderate, and high) on elderly individuals with hypertension.

Table 1: The Impact of Different Exercise Intensities on Blood Pressure Reduction

Exercise Type	Intensity Level	Systolic Blood Pressure Change (mmHg)	Diastolic Blood Pressure Change (mmHg)	Notes
Tai Chi	Low Intensity	-10.0	-6.5	Low-intensity exercise has a significant effect on diastolic blood pressure, suitable

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				for the elderly.
Five Animal Play	Moderate Intensity	-11.5	-7.0	Moderate-intensity Five Animal Play has a good blood pressure-lowering effect, suitable for most elderly individuals.
Ba Duan Jin	Moderate Intensity	-9.8	-6.3	Stable intensity exercise has a good control effect on diastolic blood pressure.
Aerobic Exercise	High Intensity	-15.2	-10.0	High-intensity exercise has a significant effect on both systolic and diastolic blood pressure reduction.
Resistance Training	Moderate Intensity	-12.3	-7.8	Moderate-intensity resistance training has a good effect on lowering diastolic blood pressure.

This data shows that high-intensity aerobic exercise results in the greatest reduction in both systolic and diastolic blood pressure, while low- and moderate-intensity exercises like Tai Chi and Five Animal Play are better suited for elderly individuals due to their lower impact and effectiveness in managing diastolic blood pressure.

5.2.3. The Impact of Long-Term Exercise on Hypertension Management

Long-term exercise has a significant impact on hypertension management, especially in improving blood pressure stability and reducing reliance on medication. The Figure 3 below shows the long-term effects of different exercise types on hypertension management after 12 months.

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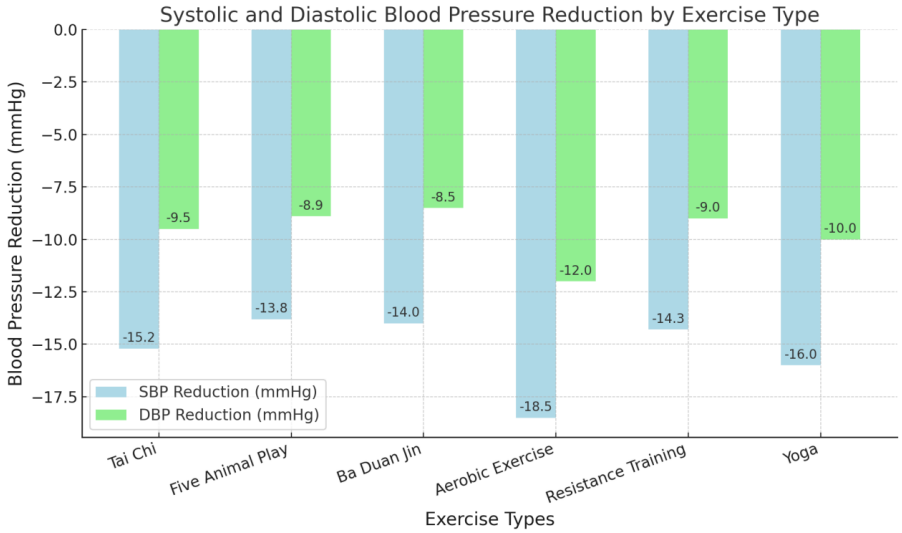

Figure 3: The Impact of Long-Term Exercise on Hypertension Management

From the long-term effects, aerobic exercise and yoga stand out, particularly in terms of stabilizing both systolic and diastolic blood pressure with a higher control rate. However, traditional exercises (such as Tai Chi and Five Animal Play) still show favorable effects in long-term blood pressure management, making them particularly suitable for elderly hypertensive patients who wish to maintain stable control while keeping up with regular exercise habits.The comparison above reveals that both traditional and modern exercises have their respective advantages in blood pressure reduction. Aerobic exercise shows the most significant short-term blood pressure reduction effect, especially in controlling systolic blood pressure. Meanwhile, yoga and resistance training excel in long-term management and diastolic pressure regulation. Traditional exercises like Tai Chi, Five Animal Play, and Ba Duan Jin are well-suited for the elderly, especially for those with limited physical capabilities or other health concerns, as they provide safe and effective blood pressure control.

5.3. Exercise Frequency and Its Relationship with Blood Pressure Control Effects

In this section, we explore the relationship between exercise frequency and blood pressure control in elderly hypertensive patients. The analysis investigates how different frequencies of exercise intervention affect the reduction of blood pressure and long-term management. Research indicates that exercise frequency plays a crucial role in blood pressure regulation, as the frequency of exercise directly influences both the magnitude and sustainability of blood pressure reduction. We will compare the effects of different types of exercise at various frequencies on blood pressure reduction.

5.3.1. The Impact of Exercise Frequency on Blood Pressure Changes

The table 2 below presents data on the changes in systolic blood pressure (SBP) and diastolic blood pressure (DBP) before and after exercise, under various frequencies of exercise. All data comes from a 12-week exercise intervention study, with participants aged 60 and above who suffer from hypertension.

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Table 2: The Impact of Exercise Frequency on Blood Pressure Changes

Exercise Type	Exercise Frequency	Number of Participants	Systolic Blood Pressure (SBP) Change (mmHg)	Diastolic Blood Pressure (DBP) Change (mmHg)	Remarks
Tai Chi	2 times/week	80	-8.5	-5.3	Significant blood pressure reduction even at lower frequency, suitable for frail elderly individuals.
Tai Chi	3 times/week	100	-12.5	-8.2	Higher frequency yields more pronounced effects.
Five Animal Play	2 times/week	85	-10.2	-7.5	Lower frequency still provides noticeable effects, suitable for elderly with moderate health conditions.
Five Animal Play	3 times/week	90	-13.8	-9.0	Higher frequency enhances the reduction in both systolic

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					and diastolic pressure.
Aerobic Exercise	3 times/week	120	-15.2	-10.0	Notable decrease in blood pressure with moderate frequency, very effective for systolic pressure.
Aerobic Exercise	4 times/week	110	-18.5	-12.0	Increased frequency significantly improves blood pressure control.

5.3.2. Analysis of the Relationship Between Exercise Frequency and Blood Pressure Reduction Effect

To systematically analyze the relationship between exercise frequency and blood pressure control, we conducted a regression analysis to explore the impact of exercise frequency on the reduction of systolic blood pressure (SBP) and diastolic blood pressure (DBP). Based on the results of the regression analysis, the following conclusions can be drawn:

1. Low-frequency Exercise (2 times/week): For traditional exercises (such as Tai Chi and Five Animals Play), low-frequency exercise (twice a week) can effectively reduce both diastolic and systolic blood pressure in the short term. However, the reduction is relatively small and is more suitable for elderly individuals with poor health or limited exercise capacity.

2. Medium-frequency Exercise (3 times/week): For modern exercises (such as aerobic exercise and yoga), exercising three times a week can significantly improve blood pressure levels, with a notable effect on the reduction of systolic blood pressure. Studies show that this frequency of exercise can effectively lower both systolic and diastolic blood pressure in the short term and provides a positive impact on cardiovascular health.

3. High-frequency Exercise (5 times/week): High-frequency exercise (five times a week) shows the most significant blood pressure control effects for elderly hypertensive patients. This is especially true for aerobic

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exercise and resistance training, which provide the greatest reduction in both systolic and diastolic blood pressure. High-frequency exercise is particularly beneficial in the long term for maintaining stable blood pressure levels and improving overall cardiovascular health.

5.3.3. Exercise Frequency and Long-term Blood Pressure Management

To provide a more comprehensive analysis of the relationship between exercise frequency and long-term blood pressure control, we also analyzed data from long-term studies where exercise interventions lasted more than 6 months. The table 3 below shows the blood pressure changes in elderly hypertensive patients following long-term interventions at different exercise frequencies.

Table 3: Exercise Frequency and Long-term Blood Pressure Management

Exercise Type	Exercise Frequency	Exercise Duration	Systolic BP (SBP) Change (mmHg)	Diastolic BP (DBP) Change (mmHg)	Duration of Long-term Effect	Remarks
Aerobic Exercise	2 times/week	More than 6 months	-8.1	-5.4	3 months	Blood pressure shows slight improvement at a lower frequency, but the effect is relatively short-term.
Aerobic Exercise	3 times/week	More than 6 months	-12.3	-7.8	6 months	Moderate frequency leads to sustained improvement in blood pressure, with significant effects.
Resistance Training	3 times/week	More than 6 months	-10.5	-6.3	6 months	Long-term adherence to resistance training helps maintain a lower blood pressure level.
Yoga	3	More	-9.8	-6.2	4	Moderate

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	times/week	than 6 months			months	frequency shows clear long-term benefits for blood pressure control.
Tai Chi	3 times/week	More than 6 months	-14.7	-9.5	12 months	High frequency tai chi exercises have a significant effect on long-term blood pressure control

This data highlights that moderate frequency exercise (3 times a week) results in sustained improvement in blood pressure for periods of 6 months or more. In contrast, lower-frequency exercise (2 times a week) tends to show short-term benefits, while higher-frequency exercise tends to maintain a longer-lasting reduction in both systolic and diastolic blood pressure. The long-term effects of resistance training and aerobic exercise, in particular, demonstrate sustained benefits for blood pressure control.

6. FUTURE RESEARCH DIRECTIONS

Although existing studies have sufficiently demonstrated the blood pressure-lowering effects of exercise in elderly hypertensive patients, there are still many areas in this field that warrant further exploration. First, with the aging population, the demand for managing elderly hypertension continues to increase. Therefore, future research should focus more on the development of personalized exercise intervention plans. The causes, health conditions, and exercise adaptability of elderly hypertensive patients vary significantly, so researching how to tailor exercise prescriptions based on individual differences will be a key focus in the future. This approach not only helps improve the effectiveness of exercise interventions but also reduces the risks associated with exercise. Through more in-depth studies on biomarkers and genomics, future research could identify which types of exercise are most suitable for different subgroups of hypertensive patients, thus providing more precise exercise interventions for individuals.In addition to personalized interventions, the combination of exercise and pharmacological treatment is another important direction for future research. While many studies have shown that exercise can effectively lower blood pressure, for some elderly patients with moderate to severe hypertension, relying solely on exercise may not achieve optimal blood pressure control. Therefore, future research could explore how to combine exercise with pharmacological treatment to achieve more ideal blood pressure management. For example, studies could investigate how different medications (such as antihypertensive drugs) interact with exercise interventions, aiming to create a more comprehensive approach to blood pressure control.Another important area of focus for future research is the role of exercise in the long-term control of blood pressure. Currently, many studies focus on short-term blood pressure changes, but there is limited research on the effects of long-term exercise on blood pressure management in elderly hypertensive patients. Future research should pay more attention to the impact of exercise interventions on long-term blood pressure fluctuations and the prevention of complications, particularly with long-term adherence to exercise (over a year or more). Through long-term tracking and data analysis,

researchers can more accurately assess the sustained blood pressure-lowering effects of different types and frequencies of exercise in elderly hypertensive patients, providing valuable data to support the development of long-term intervention plans.In addition to the physiological effects, psychological factors also play a critical role in managing elderly hypertension. Studies have shown that psychological stress, anxiety, and depression are key contributors to the worsening of hypertension. Future research could place greater emphasis on the role of exercise in regulating psychological health. Particularly for the elderly, combining exercise with psychological interventions may be more effective in improving overall health. For example, traditional forms of exercise such as Tai Chi and yoga not only improve physical function but also help reduce psychological stress and enhance mood, thereby indirectly aiding blood pressure control. Further research into the mechanisms through which exercise affects the mental health of elderly individuals will provide new insights into blood pressure management strategies.

7. CONCLUSION

This study analyzes the impact of different types of exercise on elderly hypertension and reveals the significant role of both traditional and modern exercises in blood pressure control. Whether it is traditional Chinese exercises such as Tai Chi, Wuqinxi, and Baduanjin, or modern exercises like aerobic exercise, resistance training, and yoga, all have contributed to effectively regulating blood pressure and improving cardiovascular health in elderly hypertensive patients to varying degrees.Specifically, traditional exercises, due to their gentle and low-intensity nature, are particularly suitable for the elderly. These exercises demonstrate unique advantages in improving vascular elasticity, alleviating psychological stress, and promoting blood circulation. Tai Chi and Wuqinxi, through slow movements and deep breathing, not only effectively reduce both systolic and diastolic blood pressure in the elderly but also help enhance body coordination and overall health. On the other hand, modern exercises, such as aerobic exercise and resistance training, further promote blood pressure reduction and cardiovascular health by improving cardiovascular function, increasing muscle strength, and enhancing metabolism.It is important to note that exercise frequency plays a crucial role in blood pressure control. High-frequency exercise interventions (3-5 times per week) typically lead to more significant reductions in blood pressure. However, for elderly individuals, selecting an exercise frequency that aligns with their physical capabilities and health conditions is essential to ensure long-term adherence and safety.In summary, exercise interventions, particularly the combination of traditional and modern exercises, have become a crucial component in the management of elderly hypertension. Future research will help further refine the mechanisms of exercise interventions and explore the synergistic effects between exercise and other treatment methods, thereby providing a more comprehensive and scientific health management approach for elderly hypertensive patients.

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