

In Hypertension Patients is Diet and Exercise more Effective in Lowering High Blood Pressure Compared to Exercise Alone

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Abstract

The objective of this systematic review was to explore ways of using diet and regular exercise as a means of reducing of reducing high blood pressure levels the world over. High blood pressure is fundamentally associated with high morbidity, mortality rates, and disability. Generally, lifestyle modifications such as exercise and a healthy diet have been seen to lower blood pressure in hypertensive and normotensive. A search of the literature was conducted on the Medline database to identify articles related to the research question. We also obtained the primary studies from the reference list of the retrieved review articles. The search was performed using the following key terms combination; hypertension, diet, and exercise, regular exercise, exercise alone, and lowering high blood pressure. For this project, the Medline database was searched under EBSCO host on 29th of April 2013, and there was no restriction on the years covered by the search. A total of eight articles were found to be relevant. Of all these articles reviewed, three addressed the issue of diet, and the other five addressed the issue of exercise as an intervention. Lifestyle modifications using exercise and diet was found to have a great effect in reducing blood pressure in hypertensive patients and normotensive in all the reviewed articles. There is evidence that diet and exercise have a substantial effect in reducing blood pressure in hypertensive patients and the normotensive in all the reviewed articles.

Keywords: Diet and Exercise, Exercise alone, Hypertension, Lowering High Blood Pressure.

Introduction

Hypertension is a disorder marked by an intermittent or sustained elevation of diastolic (90 mm Hg or more) or systolic (140mm Hg or more) blood pressure [1]. Despite people having interest and knowledge on the use of non-pharmacological therapy in managing hypertension, such as exercise and healthy diet, this has not been promoted at a larger scale to the general population at large. This may be due to a lack of agreement or knowledge on the type of diet and exercise to be used. Traditionally, approaches to control the epidemic of high blood pressure-related atherosclerotic cardiovascular disease (ASCVD) have concentrated on drug therapy. Despite this, still, non-pharmacological therapy such as diet and exercise have an

important and expanding role [2], to play in the management of hypertension.

Highlights on the Importance of Topic

The importance of this review is to bring on board cheaper means of managing raised blood pressure such as lifestyle modifications (diet and exercise) the world over. By so doing, there will be a reduced burden of complications due to hypertension and improved quality of life at the national and individual level. Hypertension is also known as high blood pressure, is a global public health issue; it contributes to the burden of heart diseases, stroke, kidney failure [3]. It is also a leading cause of ill health, premature mortality, and disability [4]. Hypertension is a major health problem throughout the world because of its high prevalence and its association

with increased risk of cardiovascular diseases. Hypertension is also a leading cause of morbidity and mortality among non-communicable diseases. It has shown a rapid increase in prevalence affecting the urban more than the rural population in sub-Saharan Africa [5]. Hypertension contributes to cardiac and renal failure [6], and it is a major cause of cerebral vascular accidents (CVA) [7]. Cardiovascular diseases are a major cause of disability and premature death throughout the world [8]. Hypertensive disorders of pregnancy are an important cause of severe morbidity, long-term disability, and deaths among both mothers and their babies [9]. Hypertensive disorders of pregnancy account for 12 to 20% of the total maternal death in the world and other complications such as small for gestational age babies because of impaired growth [10]. Uncontrolled hypertension will result in significant economic costs in addition to the burden of other diseases such as AIDS/HIV, malaria, and tuberculosis [10]. This disease has a severe negative impact on economic development, such as high cost of treatment, limited productivity [11], and the other economic impact of this chronic disease include the cost of illness, individual and family are affected, labor market performance, and human capital accumulation [12]. Treating the complications of hypertension entails reducing costly interventions such as cardiac bypass,

carotid artery surgery, and dialysis, which drains individual and government budgets [3]. There are many consequences of hypertension, such as premature death, disability, personal and family disruption, loss of income, and health care expenditure due to this scourge and takes a toll on families, communities, and national finances [3]. If no action is taken to tackle hypertension, the economic losses are projected to outstrip public spending on health [3]. With the researches going on to bring onboard the cheaper means of managing this illness using exercise and diet, we hope to reduce all the related costs of managing this scourge.

Research Papers and Government Documents with Statistical Figures

There are about 970 million people with elevated blood pressure worldwide, of these, 330 million are in developed countries, and 640 million are in developing countries [3]. In Zambia, hypertension affects all ages and classes and has risk factors that are mainly attributable to lifestyles such as physical inactivity and unhealthy diets [13]. During the past years for the period 2009, 2010, and 2011 hypertension has been the highest cause of visitation among non-communicable diseases to health facilities [13]. Table 1 below shows the number of hypertension patients in relation to the number of non-communicable diseases within this particular period in Zambia 2009-2011.

Table 1. Hypertension Disease for all Age Groups in Zambia for 209 to 2011

Hypertension disease for all age groups combined in Zambia for 2009 to 2011								
All ages 2009			All ages 2010			All ages 2011		
disease	number	%	disease	number	%	disease	number	%
hypertension	101181	43	hypertension	118549	34.8	hypertension	144071	35

Signs and Symptoms of Hypertension

Hypertension is called a silent killer, and it is a very serious disease since the symptoms are only known when it becomes serious. If overlooked, it may lead to serious consequences, sometimes even fatal. It is an invisible killer that

rarely causes symptoms [3]. Aside from characteristic high blood pressure, hypertension is classified according to its cause, severity, and type; the two major types are essential (also called primary or idiopathic) hypertension, the most common (90% to 95% of cases), and secondary hypertension which results from renal

disease or another identifiable cause [1]. Commonly asymptomatic and the patient is usually unaware that she or he has a disease, raised blood pressure may be discovered on routine medical examination and when complications occur such as a stroke [7]. In severe cases, patients complain of headache, palpitations, dizziness, exertional dyspnea, chest pains, and convulsions [7]. Complications due to hypertension occur late and can attack any organ system such as; cardiac complications due to hypertension occur late and can attack any organ system such as; cardiac complications may include coronary artery disease, angina, myocardial infarction, heart failure arrhythmias, and sudden death; neurologic complications may include cerebral infarctions and hypertensive encephalopathy; hypertension retinopathy can cause blindness, and renal vascular hypertension can lead to renal failure [1]. Other signs and symptoms of hypertension include fatigue, sudden loss of balance, abdominal discomfort due to high congestion in the liver, oliguria due to reduced renal perfusion, peripheral edema, cyanosis, peripheral vasoconstriction, jugular venous distension, systolic murmur in mitral or tricuspid regurgitation can be heard and pulmonary crackles due to fluid transudation, especially pulmonary congestion.

Epidemiological Data

Prevalence trends and incidence are important epidemiological considerations for hypertension, the leading cause of cardiovascular diseases [14]. Hypertension is prevalent all around the world, with one in three adult's lives with hypertension [11]. The largest deaths due to non-communicable diseases are due to hypertension accounting for 48% due to the adoption of western lifestyle by people in developing countries, and it is said to have led to a sharp rise in the incidence of hypertension [10]. Hypertension affects more than 60 million adults in the United States of America, blacks are twice as likely as whites to be affected, and they are four times as likely to die of the disorder [1]. In 2008, worldwide, approximately 40% of adults

aged 25 years and above had been diagnosed with hypertension; the number of people with the condition rose from 600 million in 1980 to 1 billion in 2008, the prevalence of hypertension is highest in the African region at 46% of adults aged thirty and above, while the lowest prevalence at 35% is found in the Americans [3]. The increasing prevalence of hypertension is attributed to population growth, aging, and behavioral risk factors, such as unhealthy diet, lack of physical activity [3].

Age, Gender Affected by Hypertension

Hypertension is associated with identifiable behavioral and biological risk factors such as race, obesity, diabetes, age, sex, alcoholism, sedentary lifestyles, diet (salt), and family history of hypertension [4]. Age is a major risk factor for hypertension, in that blood pressure increases with age in both men and women. Blacks are twice as likely as whites to be affected, and they are four times likely to die of the disorder [1]. Before the age of 55 years, men are more affected with hypertension than women, and after this age, the reverse is true [15]. African Americans are six times more likely to develop end-stage renal disease from hypertension than whites. More than 40% of African men and women have hypertension and accounts for over 40% of all death in this group. Hypertension is also becoming more common in children and teenagers, among young people; boys are at higher risk for high blood pressure than girls.

Pathophysiology

Most cases are idiopathic, and a few cases (less than 5%) may be caused by other diseases [7]. Increased blood volume, cardiac rate, stroke volume, or arteriolar vasoconstriction that increases peripheral resistance causes blood pressure to rise [1]. Abnormalities in the neurohormonal activation and water and electrolyte balance also play a central role in the cascade that leads from hypertension to heart failure [14]. Angiotensin 2 is an important initiator of extracellular matrix remodeling,

which contributes to the pathogenesis of atherosclerosis and cardiac hypertrophy [14]. The heightened sympathetic nervous system predisposes to vasoconstriction, sodium retention, and ventricular hypertrophy; the latter occurs as increased noradrenaline release results in myocyte hypertrophy, increased apoptosis of cardiomyocytes, and deficits in cardiomyocyte contractility; these changes are facilitated by B – adrenoceptor hyperactivity [14].

Risk Factors

The risks factors for hypertension include Tobacco use, physical inactivity, unhealthy diet (rich in salt, fat, and calorie), high blood pressure, cholesterol, diabetes, overweight, and stress.

How the Disease is Managed in Practice

The purpose of treatment is to prevent complications [7]. Management is according to the cause and type of hypertension condition. Blood pressure drugs work in several ways by removing excess salt and fluid from the body, slowing the heartbeat, or relaxing and widening the blood vessels [3].

Although hypertension has no cure, drugs and modifications in diet and lifestyle can control it. Generally, non-drug treatment, such as lifestyle modification, is tried first, especially in early and mild cases [1].

If the diastolic pressure remains above 90 mm hg despite at least six months of non-drug treatment, monotherapy may begin, thiazide diuretic or a beta-blocker is the drug of choice; initially, this therapy is preferred because studies have demonstrated a decrease in morbidity with this therapy [1].

The General Outcome Measures

Early detection, lifestyle modifications such as healthy diet and regular exercises play a significant role in better hypertension outcomes. If hypertension is left untreated it causes severe complications such as coronary heart artery disease, angina, myocardial infarction, heart

failure, arrhythmias, sudden death, and stroke [1].

The Effects on Patients' Lives

Cardiovascular diseases are a major cause of disability and premature death throughout the world [8]. Treating the complications of hypertension entails costly interventions such as cardiac bypass, carotid artery surgery, and dialysis, hence draining individual budgets [3]. Premature death, disability, personal and family disruption, loss of income, and health care expenditure due to hypertension take a toll on families, communities [3]. The results of complications due to hypertension have negative impacts on the patient's life, such as reduced quality of life, psychological disturbance, disability, and pain, increased deformity due to stroke, and also sexual disturbances due to erectile dysfunction.

The Significance of this Study

The major importance of doing this study was to find ways of incorporating diet and exercise in our daily life in order to reduce; high blood pressure, the likely complications, and also to reduce the prevalence and incidence of raised blood pressure.

By introducing diet and exercise as a means of lowering raised blood pressure which is less costly, there is hope to reduce the huge budgets spent on procuring these conventional drugs by governments and the donor community with diet and exercise; there is anticipation that the severe side effects from conventional drugs such as erectile dysfunction would be reduced. Furthermore, the economic consequences and biological uncertainties of long-term pharmacological treatment of hypertensive persons urge that alternative treatments should be examined, such as reduced salt in food and exercising [16].

Objectives of the Study

The objective of this review was to investigate the effect of diet and exercise as

interventions on blood pressure in hypertension patients. Specifically, this review aimed;

1. At synthesizing evidence from research papers assessing the effectiveness of healthy diet and exercise in lowering high blood pressure in hypertension patients compared to exercise alone.
2. Discussing how diet and exercise can be developed in order to reduce raised blood pressure in hypertensive patients.
3. At assessing the relationship between exercise and diet with hypertension.

Methodology

Creating Criteria for Selecting Evidence into this Review

It has been said that high-quality systematic review should have inclusion criteria that is vigorously and transparently reported so that the search targets articles that will provide answers to the review question, leaving the irrelevant ones [17]. The criteria for selecting these studies followed from the research question and the identified PICO (population, intervention, comparison, and outcome) components [17]. This well-formulated question had key components that were used in the criteria for selecting studies for this review [18]; these key components of interest are population, interventions, comparison, and outcome. The clinical question was “in hypertension patients, is diet and exercise more effective in lowering high blood pressure compared to exercise alone.” Since the clinical question was formulated, the next step was to find relevant evidence that would answer the clinical question [19].

The first stage in selecting studies involved the checking of results from electronic search and assessing the titles and abstracts to assess whether they met the predetermined criteria for eligibility [18]. Table 2. Shows articles that were relevant to the aims of the focused question that were also identified by checking the reference list of retrieved articles in order to identify the primary studies.

Types of Studies

The articles included or that were relevant for this focused question are randomized controlled trial articles because, looking at the hierarchy of evidence, they are said to be the best. The other reason for inclusion is that they were addressing the question to be reviewed [18]. A randomized controlled trial is also exhaustive in addressing a clearly defined question [20].

These should have the population of interest, which is hypertension patients, the intervention of interest, which is diet and exercise, the comparison, which is exercise alone, and the outcome of interest is reduced blood pressure. All the studies that have mentioned the intervention of interest, either diet or exercise, were included in order not to miss some articles that may be relevant, and also in that it may be difficult to find studies that have this type of combination intervention.

Types of Participants or What is the Problem

Looking at the research question on the population of interest, “hypertension patients,” there was no restriction on age, sex, race because hypertension affects all.

Types of Interventions/Issues

The type of intervention that was of interest in this focused question was all types of diet and exercises. There was no restriction on the type of diet or exercise but a duration of two to fifty-two weeks.

Types of Comparison

The comparison of interest in this focused question was exercise alone in reducing high blood pressure. All types of exercises were considered duration two to fifty-two weeks.

Types of Outcome Measures

The desired outcome in this clinical research question was lowering elevated blood pressure or preventing hypertension hence reducing incidences and severity of this disease. The other outcomes of importance that were desired are

reduced deaths, improved physical and emotional wellbeing, improved quality of life

and also improved social-economic outcomes [21].

Table 2. Summary of Inclusion and Exclusion Criteria

	Inclusion	Exclusion
Population	All hypertension patients	All studies that did not include hypertension patients
Intervention	All types of diet and exercises	All studies that did not include either of the two interventions
comparison	Exercise alone	
Outcome	Reduced high blood pressure	If the method of outcome assessment were inadequately described.
Types of studies	All randomised controlled trials (RCTs)	Commentaries, review documents, case studies

The Search Strategy

Search strategy was very important so that relevant articles are not omitted [20]. The research question was “in hypertension patients is diet and exercise more effective in lowering high blood pressure compared to exercise alone”. Since the search question was in place the next step was to focus on the key components of the question for initial search strategy [18]. Since the clinical question is health related a health-related electronic bibliographic database was searched. The databases used to search were

Medline because they include abstracts for majority of recent records and it is considered as one of the richest sources of trials [18]. Medline is the most widely used database for searching the biomedical literature and it is freely available on the internet, it is also updated regularly and is relatively user friendly [19]. For this project Medline database was searched under EBSCO host on the 29th April 2013, there was no restriction on the years covered by the search [18]. The PICO elements of the focused question are shown in Table 3 below.

Table 3. PICO Elements (Keywords) of the Focused Question

Population	Intervention/issue	comparison	Outcome
Hypertension patients	diet and exercise	Exercise alone	Lowering high blood pressure

Since the PICO elements (keywords) in the focused question have already been identified, these are population (**hypertension patients**), intervention (**diet and exercise**), comparison (**exercise alone**) and outcome (**lowering high**

blood pressure). The next thing was to find relevant evidence to the clinical question [19].

The Table 4 below shows the synonyms to the keywords in the research question.

Table 4. Synonyms to the Key Words

PIO	P	I	C	O
Keywords	hypertension	Diet and exercise	Exercise alone	Lowering high blood pressure
Synonyms	1. High blood pressure patients	1.Food and workout	1.workout	1.Reduce hypertension
	2.Cardiovascular patients	2.Meals and training	2.training	2.Cut cardiovascular disease

Since all the synonyms related to keywords in the focused question have been generated, then the keywords and the generated synonyms are combined using Boolean operators “OR” and “AND”. Boolean operators AND allows only articles containing both terms to be retrieved, while OR allows articles containing either term to be retrieved [19]. The CINAHL database was used in line with the focused question, which was medical in nature. Boolean operators “AND” and “OR” were used to narrow (specificity) and broaden (sensitivity) the search, respectively.

The ability to search databases effectively is an important aspect of evidence-based research; this is dependent upon a well-focused question and the ability to break it down into PICO terms and finding synonyms.

Assessing the Methodological Quality of the Evidence

The quality of evidence generated depends on the quality of the primary studies that make up the review [17]. The types of study design for this clinical question are randomized controlled trials. Assessing the methodological quality of the included studies is an important part in evidence-based practice. Since all relevant articles on the subject have been obtained, the next step was to appraise the evidence for its validity and clinical usefulness [19]. The most important component of critical appraisal is an evaluation of the appropriateness of the study design for the research question and careful assessment of key methodological features of the design [22]. The assessment of the validity, both internal validity (the degree to which the study provides valid evidence for the population and setting in which it was conducted) and external validity (the extent to which the evidence is relevant and generalizable to the population and conditions of typical primary care practice) has an important role throughout the process and is evident in the detailed reporting of individual quality items of all included studies. Validity means the extent the research study actually

measures that which it is designed to measure. To do all this, several tools are available for appraising different research articles/designs; these are CASP [23]. The tools are simple, easy to use, and freely available on the internet. For this project, randomized controlled trial frameworks were be used; different studies use different frameworks according to research design.

Results

Search Results

The number of retrieved articles from the search strategy was eight; all were reviews and from the reference list of these retrieved articles was forty-three. After applying inclusion and exclusion criteria at the title and abstract level, eight articles were identified as relevant. This search was conducted on the Medline database under EBSCO host using keywords and generated synonyms. Only the eight randomized controlled trials from the reference list were included because they were primary studies and had the PICO components of the research question. Table 5 below shows the search results of the included articles.

Summary of the Evidence that has been Included in the Project

The summary of the evidence included in this project is shown in Table 6.

Summary of the methodological quality of the evidence

The methodological quality of all included articles was assessed; these are randomized controlled trials. A critical appraisal skill program scale or tool was used to assess the quality of all the articles that met the inclusion criteria. The methodological quality looks at internal and external validity, reliability, and overall rigor. The (Table 7.) below shows a summary of the methodological quality of included articles. These tools assess the quality of all the articles that met the inclusion criteria.

Table 5. Search Results, Data Base, Searched and Number of Articles

Data base or method	Number of articles found from search	Number of articles discarded due to irrelevant title	Number of articles duplicated from another database	Number of articles discarded at abstract	Number of articles to review by title and abstract
Medline (EBSCO HOST)	8	1	0	7	0
Checking of the reference list	43	35	0	0	8

Table 6. Summaries of Evidence of the Included Articles in this Review

Study by	Main aim	method	Main findings	conclusion
Svetkey L.P., Simons-Morton D.G., Vollmer W.M., Appel L.J., Conlin P.R., Ryan D.H., Ard J. and Kennedy B.M., 1999.	To determine the effects of dietary patterns on blood pressure in subgroups.	The study design was a randomised controlled trial. This was done at four academic centres. Sample size was 459 adult hypertensive patients. The sampling method was by probability sampling (simple random) computer generated. Study duration was 8 weeks. Data collection method was completing a daily diary and direct observation.	The combination diet significantly lowered both systolic and diastolic in all subgroups. The DASH diet lowered systolic blood pressure significantly more in African American than in whites.	The DASH combination diet may be an effective strategy for preventing and treating hypertension across all population groups.
Sacks F.M., Svetkey L.P., Vollmer W.M., Appel L.J., Bray G.A., Harsha D., Obarzanek E., Conlin P.R., Miller Iii E.R., Simons-Morton D.G., Karanja N. and Pao-Hwa Lin, 2001.	The aim was to study the effects of different levels of dietary sodium in conjunction with the dietary approaches to stop hypertension (DASH) diet which is rich in vegetables, fruit and low-fat dairy products in persons with and those without hypertension.	The study design was randomised controlled multicentre. Sample size was 412 hypertensive and none hypertensive. Duration of the study was from September 1997 to November 1999. The sampling method was by simple random. Data collection method was by questionnaires, daily food dairies, measuring of 24 hours urinary excretion.	Reduction in sodium intake significantly lowered systolic and diastolic blood pressure both in the control and DASH diet.	Reduction of sodium intake to levels below the current recommendation of 100mmol per day and the DASH diet both lower blood pressures substantially, with greater effects in combination than singly.

Margetts B.M., Berlin L.J., Vandongen R. and Armstrong B.K., 1986.	Was to examine the effects of a vegetarian diet in subjects with mild hypertension and also to as nearly as possible the diet of long-term vegetarians.	Randomised trial of 58 hypertension patients aged 30 to 64 years. Duration six weeks. Sampling method was simple random. Data collection method was dietary records, standiometer for height, weight using beam scale, questionnaires were completed	There was fall in blood pressure in vegetarian diet of about 5mm hg in untreated subjects with hypertension.	The study has shown that in untreated subjects with mild hypertension, changing to vegetarian diet may bring about a worthwhile fall in systolic blood pressure.
Moreira W.D., Fuchs F.D., Lawrence J., Iberia J.P. and Appel, 1999.	The main aim was to assess the effect of six months of resistance or endurance exercise training on blood pressure in health 70-79 years old men and women with normal and elevated blood pressure.	The design was randomised controlled trial. Location was at the hypertension unit of the hospital de Clinicas de Ponto Alegre. The sample size was 28 sedentary hypertension patients; the duration was ten weeks physical training. Sampling method was probability sampling. Data collection method was recording heart rate and blood pressure from particular measuring instruments.	Across all participants, a reduction in systolic blood pressure was significant.	The conclusion is that aerobic training programs at 20% and 60% of the maximum work capacity have similar effects on ambulatory blood pressure.
Cononie C.C., Graves J.E., Pollock M.L., Philips M.I., Summers C., and Hagberg J.M. 1991.	The main aim was to assess the effect of six months of resistance or endurance exercise training on blood pressure in health 70-79 years old men and women with normal and elevated blood pressure.	Design was randomised controlled trial. Sample size was 56 male and female. Duration was six months. Sampling method was by stratified random. Data collection method was by objectively measuring using different instruments such as random-zero sphygmomanometer.	Endurance exercise training produces modest reduction in blood pressure in 70-79 years old individuals.	It appears that healthy men and women in their seventies with moderate hypertension can lower their blood pressure with endurance exercises to the same degree as can young and middle-aged hypertensive.
Martin J.E., Dubbert P.M. and Cushman W.C., 1990.	To determine the antihypertensive efficacy of aerobic exercise training in mild essential hypertension.	This was a randomised controlled trial crossover. This was done at an outpatient research clinic in a university-affiliated veteran's administration medical centre. Sample size was 27 men with untreated	The study provides evidence for the independent antihypertensive effect of aerobic exercise in mildly	This study demonstrates that moderate aerobic exercise lowers blood pressure in hypertensive subjects and might be an important

		diastolic blood pressure of 90 to 104. Duration was 10 weeks sampling method was simple random. Data collection method was by objectively measuring by different instruments such as random-zero sphygmomanometer.	essential hypertensive men who were not on medication.	modality in the control of hypertension.
Gunjal S., Shinde N., Kazi A. and Khatri S., 2013	The aim was to study the effect of aerobic interval training on blood pressure and myocardial function in hypertensive patients.	The design was an experimental (pre-post) design. Location of the study was at department of cardiorespiratory physiotherapy pravara rural hospital, Ioni, India. Participants were 30 hypertensive patients. Duration of the study was 12 weeks. Sampling method was non-probability. Data collection method by B mode images was recorded and by modified biplane Sampson's method.	There was significant reduction in blood pressure and there was improvement in ejection fraction, stroke volume, cardiac output and peripheral resistance decreased by 17% after aerobic interval training.	The study indicates that aerobic interval training is effective to reduce blood pressure and heart rate and improves myocardial function in hypertensive patients and that moderate to high intensity of the three weekly bouts of interval training for 12 weeks reduced blood pressure and improved cardiac function.
Liu S., Goodman J., Nolan R., Shawn L.S. and Scott G., 2012.	The main aim was to assess the relation between the degrees of post exercise hypotension with acute exercise and also to examine the correlates of blood pressure reduction after chronic exercise in both sexes.	The design was quasi experimental study we are told the study benefited from a longitudinal study design. Location was at university of Toronto athletic centre. 17 participant's duration 8 weeks. Sampling method was non-probability. Data collection method questionnaires were completed, training was recorded in a weekly log.	Blood pressure was significantly reduced relative to the baseline after 30 minutes of acute and chronic exercises.	The magnitude of the acute blood pressure lowering with exercise may predict the extent of blood pressure lowering after chronic training intervention in prehypertension individual and that lifestyle intervention and in particular chronic aerobic exercises may prevent or delay the development of hypertension.

Table 7. Summaries of Methodological Quality of Included Articles

Study by	Internal validity	External validity	reliability	Overall rigour
Svetkey L.P., Simons-Morton D.G., Vollmer W.M., Appel L.J., Conlin P.R., Ryan D.H., Ard J. and Kennedy B.M., 1999.	Was high due to random allocation of participants, similarity of groups at baseline, computer generated random allocation, blinding of staff, concealment of allocation, data analysis was done on an intention to treat analysis, control of variables, adequacy of follow ups, data collection methods through questionnaires, observation and completed dairies.	High due to the following sample size was 459, probability sampling method, cluster eligibility was followed, acceptability of intervention, outcome measures were considered such as change in systolic and diastolic blood pressure, exclusion and inclusion, power analysis. The article did not mention anything on dropout.	High due to use of standard tools such as random zero sphygmomanometer, data analysis instruments such as SAS software package.	Strong due to intervention and intended outcome.
Sacks F.M., Svetkey L.P., Vollmer W.M., Appel L.J., Bray G.A., Harsha D., Obarzanek E., Conlin P.R., Miller Iii E.R., Simons-Morton D.G., Karanja N. and Pao-Hwa Lin, 2001.	High due to random allocation of participants, concealment of allocation, blinding of participants and dietary staff, similarity of groups at baseline, intention to treat analysis, adequacy of follow ups, data collection (diaries and questionnaires) methods, statistical analysis and there was control of variables.	High due to sample size of 412 participants, probability sampling method, cluster eligibility (exclusion and inclusion), cluster generalizability, outcome of systolic and diastolic blood pressure. The study did not mention anything on dropouts, and acceptability of intervention and power analysis.	High due to the use of standard tools such as random zero sphygmomanometer.	strong
Margetts B.M., Berlin L.J., Vandongen R. and Armstrong B.K., 1986.	High due to control of variables, random allocation, concealment of allocation, similarity of groups at baseline, intention to treat analysis, adequacy of follow ups, data collection methods such as questionnaires,	High due to sample size 58 participants, probability sampling method, cluster eligibility (exclusion and inclusion), cluster generalizability, outcome of interest, dropouts were taken care. Though there is no mention of	High due to use of standard tools such as standard mercury sphygmomanometer, automatic oscillometric device, specialist physicians, stadiometer	strong

	statistical analysis. But blinding was not done.	acceptability of intervention, power analysis.	for height, beam scale for weight and auto analyser	
Liu S., Goodman J., Nolan R., Shawn L.S. and Scott G., 2012.	Low because there is no blinding, random allocation, concealment of allocation, intention to treat analysis. The other things were taken into consideration such as control of variables, similarity of groups at baseline, adequacy of follow ups, data collection methods (questionnaires and recording), and statistical analysis.	High due to sample size 17 participants using power calculation, outcome of interest was systolic and diastolic blood pressure, follow ups adequate all completed (no drop out) the study, cluster eligibility, cluster was done. The sampling method was non-probability. There is no mention on acceptability of intervention.	High due to use of standard tools, such as heart rate monitor watch, automated oscillometric brachial blood pressure device, applanation tonometry for arterial stiffness and finometer MIDI MODEL-2 for blood pressure beats, ANOVA was used for evaluation and automated sphygmomanometer for brachial blood pressure.	Slightly weak
Gunjal S., Shinde N., Kazi A. and Khatri S., 2013	Low due to none blinding, no concealment of allocation, no random allocation, intention to treat analysis not mentioned, statistical analysis not done. Others were done such as similarity of groups at baseline, adequacy of follow ups, data collection method and control of variables.	Low due to sample size, sampling method non-probability, cluster generalizability not mentioned, and acceptability of intervention not mentioned, power analysis was not done. Cluster eligibility was done, outcome, exclusion and all these were done.	High due to use of standard tools, such as karvonen's formula for exercise intensity, sphygmomanometer for blood pressure, pulse oxymeter for heart rate, modified biplane Sampson's method for ejection fraction and echocardiography was done by experienced	Slightly weak

			cardiologist using vivid 7 scanner with m35 probe	
Martin J.E., Dubbert P.M. and Cushman W.C., 1990.	High due to blinding, control of variables, random allocation, concealment of allocation, similarity of groups at baseline, adequacy of follow ups, data collection methods. These others are not mentioned, statistical analysis, and intention to treat analysis.	High due to sample size, sampling method inclusion (probability), cluster eligibility, dropouts, exclusion and inclusion criteria. These others are not mentioned cluster generalizability, acceptability of intervention, outcome, and power analysis.	High due to use of standard tools such as random zero sphygmomanometer, specialist nurse assessed the blood pressure, and ANOVA was used to analyse variance.	strong
Cononie C.C., Graves J.E., Pollock M.L., Philips M.I., Summers C., and Hagberg J.M. 1991.	High due to, control of variables, random allocation, concealment of allocation, similarity of groups at baseline, though there is no mention of intention to treat analysis, adequacy of follow ups, data collection methods, statistical analysis and blinding.	High due to sample size 56 participants, sampling method (probability), cluster eligibility, dropouts accounted, exclusion and inclusion used. Cluster generalizability, acceptability of intervention, outcome, and power analysis are not mentioned.	High due to use of standard tools such as random zero sphygmomanometer, and computerised collier co2 rebreathing technique for cardiac output.	strong
Moreira W.D., Fuchs F.D., Lawrence J., Iberia J.P. and Appel, 1999.	High due to blinding, control of variables, random allocation, concealment of allocation, similarity of groups at baseline, intention to treat analysis, statistical analysis, though adequacy of follow ups, data collection methods are not mentioned.	High due to sample size of 28 participants, sampling method (probability), cluster eligibility, exclusion and inclusion. Cluster generalizability, acceptability of intervention, outcome, dropouts, and power analysis are not mentioned.	High due to use of standard tools such as model PIV device for blood pressure and treadmill for physical fitness.	strong

Synthesis of the Main Findings from the Evidence

All the studies have shown that lifestyle modifications such as diet and exercise lowered blood pressure in hypertensive patients.

Table 8a shows the reduction of blood pressure in different types of exercise. In Moreira et al. mean 24 hours systolic blood pressure fell from 137.2 plus or minus 14.9 to 135 plus or minus 12.7 mm Hg, and the mean diastolic blood pressure fell from 92.1 plus or minus 10.0 to 89.3 plus or minus 7.7 mm Hg. In Cononie et al. the reduction in blood pressure in the endurance training group initial systolic blood pressure was 139 plus or minus 16, diastolic 81 plus or minus 8 mm Hg and after six-

month blood pressure fell to systolic 135 plus or minus 17, diastolic 76 plus or minus 7 mm Hg. In martin et al., blood pressure was reduced from systolic 136.6 mm Hg and diastolic 94.8 mm hg to systolic 130.1 mm Hg and diastolic 85.2 mm Hg. In Gunjal et al., blood pressure reduced from systolic 152 plus or minus 12 mm Hg and diastolic 96 plus or minus 8 mm Hg to systolic 140 plus or minus 12.5 mm Hg and diastolic 84 plus or minus 8 mm Hg. In Lui et al. blood pressure reduced from systolic 126 plus or minus 1.8 mm Hg and diastolic 81 plus or minus 1.1 mm Hg to systolic 120 plus or minus 1.8 mm Hg and diastolic 75 plus or minus 1 mm Hg. Overall, there is a trend of reduced blood pressure from high to lower levels.

Table 8a. Below Pre and Post Exercise Intervention Blood Pressure Levels of Each Study

		Before intervention		After intervention	
Study by	intervention	systolic	diastolic	systolic	diastolic
Cononie et al 1991.	Endurance exercise	139 ± 16 mm Hg	81 ± 8 mm Hg	135 ± 17 mm Hg	76 ± 7 mm hg
Martin et al 1990	Aerobic exercise	136.6 mm Hg	94.8 mm Hg	130.1 mm hg	85.2 mm Hg
Moreira et al 1999	Physical training exercise	137.2 ± 14.9 mm Hg	92.1 ± 10 mm Hg	135.2 ± 12.7 mm Hg	89.3 ± 7.7 mm Hg
Gunjal et al 2013	Aerobic interval training exercise	152 ± 12 mm Hg	96 ± 8 mm Hg	140 ± 12.5 mm Hg	84 ± 8 mm Hg
Liu et al 2012	Acute and chronic aerobic exercises	126 ± 1.8 mm Hg	81 ± 1.1 mm Hg	120 ± 1.8 mm Hg	75 ± 1 mm Hg

Table 8b shows different types of diets and there lowering effect on blood pressure. In Svetkey et al. the DASH diet significantly lowered systolic and diastolic blood pressure by 11.4 mm Hg in all subgroups p=0.03. In Sacks et

al. DASH and low sodium lowered blood pressure by 11.5 Hg in hypertensive patients p<0.001. In Margetts et al. the fall in blood pressure following a vegetarian diet was 5 mm Hg p<0.05.

Table 8b. Pre and Post Diet Intervention Blood Pressure Levels of Each Study

		Before intervention		After intervention		
Study by	Intervention	Systolic	Diastolic	Systolic	Diastolic	P value
Svetkey et al 1999	DASH diet	160 mm Hg	95 mm Hg	148.6 mm Hg	83 mm Hg	P=0.03
Sacks et al 2001	DASH plus sodium diet	134 mm Hg	86 mm Hg	122.5 mm Hg	74.5 mm Hg	P<0.001
Margetts et al 1986	Ovolactovegetarian diet	154.4 mm Hg	98.5 mm Hg	149.4 mm Hg	93.5 mm Hg	P<0.05

Discussion

Summary of Key Findings

There is good evidence from all the identified articles. All the included studies have identified diet and exercise as a means to reduce or lower blood pressure. Though the articles included did not exclusively just discuss on exercise and diet, it was one of the areas of study interest. Nevertheless, all the articles touched on the condition of interest, which is hypertension. It has been noted that hypertension patients greatly benefit from diet and exercise, lowering the effect on blood pressure. The treatment effect of exercise and diet on hypertensive patients was substantial. These lifestyle modifications (diet and exercise) have been highly recommended in these included studies.

Although the included articles in this review seem to have been of short duration, they seem to have been intensive studies because most of these were relevant to issues of long-term sustainability, which is of prime importance in clinical practice and in determining the public health impact of the studies considered.

Interpretation of Key Findings

Most of the findings were in line with the main objective, which is ‘to investigate the effect of diet and exercise interventions on blood pressure in hypertension patients. The problem of validity makes it difficult to make firm conclusions on the basis of the articles considered and makes it probable that the

findings reported are overestimates of the effect that might be achieved in practice.

The randomized controlled trials evidence was good though there was no study that looked at the intervention of interest the way it appears in the research question. In this review, the intervention of interest is diet and exercise, but most articles retrieved looked at either diet or exercised singly. All the randomized controlled trial included in this review was relevant to the research question and were of good methodological quality. Randomized controlled trials were explicit, reproducible and up to date. They were conducted in an explicit and well-structured methodology which minimized the possibility of bias. Some of these studies were not explicit and were not well structured methodologically, which brought in the possibility of bias. Despite these shortcomings these studies had important information relevant to the research question and objective.

Finding on Objective One

Objective number one was ‘to synthesize evidence from research papers assessing the effectiveness of healthy diet and exercise in lowering high blood pressure in hypertension patients compared to exercise alone’. In relation to this objective, all the included studies have evidence to support the use of diet and exercise as a means of lowering high blood pressure. The evidence was found in all the eight included articles. In all these articles, reduction in blood pressure was significant.

Findings on Objective Two

Objective two was 'to discuss how a healthy diet and exercise and can be developed in order to reduce raised blood pressure in hypertensive patients. This means of lowering blood pressure is reasonably priced, low risk, and easily implementable. DASH diet includes most of the readily available foods, which are well accepted in most populations. The estimate of cost places the DASH diet between low-cost and moderate-based foods. High and moderate exercise have been seen to have the same effect on blood pressure as such, it has been recommended as a safe and efficacious intervention.

Findings on Objective Three

The last objective was on the assessment of the relationship between exercise and a healthy diet with hypertension. In all the five articles on exercise as an intervention means of lowering blood pressure, the effect has been seen even in chronic and acute exercises. Whether high or low-intensity trainings, the blood pressure-lowering effect was substantial. It also found that a vegetarian diet lowered blood pressure in untreated subjects with mild hypertension. Even when other factors were held constant, the DASH diet lowered blood pressure. Foodless in sodium significantly lowered blood pressure in both control and DASH diets.

Limitations of the Study

The major limitations of this review were that none of these included articles looked at diet and exercise combined as an intervention and then comparing it with exercise alone. This search may also have been limited by none usage of truncation and wildcat symbol. If this search was to be repeated, efforts would be made to find all variant spellings and also variant endings (plural or singular) in order to increase sensitivity. The other limitation was that the confounding factors in other studies were not taken care of; hence they may have altered the outcome of interest. The other limitation is that most of these studies were of short duration.

Implications and Application to Practice of the Study

All the included articles showed a lot of factors and results that can be applied since most important factors that are related to individual and policy were considered where it might contribute to change the policy and practice. There is an acknowledgement that conventional treatment has done little to reduce the number of patients with hypertension. The research has found an alternative to reducing high blood pressure, such as lifestyle modifications (diet and exercise). Emphasis is now being placed on efficient and cost-effective strategies for diagnosing and managing hypertensive patients. Recent evidence from most studies indicates that non-pharmacological therapy, which includes dietary potassium and calcium supplements, reduction of salt intake, regular exercise, a diet high in fibre and low in cholesterol and saturated fats, produces a significant reduction in blood pressure. In most of the studies, salt restriction and increased physical activity are generally accepted lifestyle measures in the management of hypertension. In the studies that involved physical activities, the reduction in blood pressure was not related to the intensity of the exercises. The dietary approaches to stop hypertension (DASH) diet is also highly recommended in most of the studies done, and it was very effective in reducing blood pressure in both hypertensive and non-hypertensive. In line with the objectives of this study, it has been seen that diet and exercise play a major role in high blood pressure reduction.

Indication for Further Research

One of the areas that need further consideration is the sample size (should be bigger to be able to generalize the findings); longer duration for the research, also there is a need to reduce confounding factors. There is a need to assess the long-term safety, use, and acceptability of the intervention by communities. Most of these researches were done at higher-level centers, and there is a need

to go to lower-level communities who are not tapped. There is also a need to look at how exercise and diet impact on the quality of life and mortality rates.

Recommendations

Recommendations such as to eat well and exercise are generally safe and inexpensive and likely to have desired benefits. Most of the articles have recommended the use of diet and exercise in lowering high blood pressure. Most research on dietary approaches to stop hypertension (DASH) combination diet, which contains large amounts of fruit, vegetables, fish and nuts, low-fat dairy products, and reduced levels of total and saturated fat, together with exercise, have been effective in lowering high blood pressure. First, all stakeholders, both in government and individuals, must put in more effort to tap knowledge on the issue of exercise and diet for the management of hypertensive patients. This, I believe, could be done by educating practitioners and teaching them how to document exercise and diet in their practice.

It is important that all medical practitioners are introduced to this new research development in order to have standard health care that cut across all board. It is worth noting that the differences between pharmacological and none pharmacological are not necessarily anything but the way they are used. In recognizing the scientific aspects of exercise and diet, one needs to be cautious of not relegating conventional aspects of the practice. Patients with elevated blood pressure should follow a weight-reducing diet and also take regular exercises and restrict salt intake.

Just as various measures have been put in place by the governments to enhance the services of conventional medicine, attention must be also be given to exercise and diet. Budgetary allocations must much match that of a conventional system. Government must enhance efforts by scaling up the use of exercise and diet. In so doing, the government must put

ineffective regulatory bodies to periodically check the works of these health posts.

I'm absolutely in support of advocacy for the use of exercise and diet; I think such an idea will not be bad at all considering the fact that many people use exercise and diet in their daily lives. It is imperative for people to realize that exercise and diet have been in our daily practices. Therefore, it is crucial for one to separate diet and exercise from our daily lives.

Integrating exercise and diet into the national health care policy of Zambia would be an action in the right direction. There must therefore be a much stronger national policy and regulatory framework on issues pertaining to safety, efficacy, quality, access, and rational use of diet and exercise.

Diet and exercise may treat and cure diseases that are currently leading to humans' potential extinction. If actions are taken soon to study and protect this new means of treating hypertension, these lifestyle modifications may find themselves to be the best means of reducing hypertension.

Conclusions

For a long time, people have lived with the impression that only conventional medicines can treat hypertension; it is time we consider such viewpoints once more. These studies have shown that diet and exercise can holds a vibrant role in the dispensation of good health practices the world over. Most of these studies have acknowledged the potency and prospects of using exercise and diet even with the presence of conventional medicine. It is evident from these studies that diet and exercise can be an alternative, not just complementing conventional medicine.

From the studies, it is clear that exercise and diet will reach one 100% usage among hypertensive patient; as such, clinicians should come together and fashion ways of enhancing the use of exercise and diet to reduce high blood pressure. Again, since diet and exercise play a central role in the general life of many people, it

is important for the health systems to embrace this in its practices since there is empirical evidence to support its relevance to indigenous healing. Therefore, if there would be a comprehensive medical system world over, exercise and diet must find its way into practice.

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Conflict of Interest

Himwaaba Gift declares no conflict of interest.

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