Journal of Advances in Medicine and Medical Research

22(3): 1-21, 2017; Article no.JAMMR.33179
Previously known as British Journal of Medicine and Medical Research
ISSN: 2231-0614, NLM ID: 101570965

Lifestyle Modification and Adherence: An Inseparable Measure in Hypertension Control

Uwaegbulem, Mirian Nkeiruka[1*]

[1]Department of Nursing, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JAMMR/2017/33179
Editor(s):
(1) Domenico Lapenna, Associate Professor of Internal Medicine, Department of Medicine and Aging Sciences, University "G. d'Annunzio" Chieti-Pescara, Chieti, Italy.
Reviewers:
(1) Reda Abdelmoaty Abdallah Goweda, Suez Canal University, Egypt.
(2) Stefano Omboni, Italian Institute of Telemedicine, Italy.
(3) Jerzy Bełtowski, Medical University, Lublin, Poland.
(4) Mariya Klunnyk, Cell Therapy Center EmCell, Kyiv, Ukraine.
Complete Peer review History: http://www.sciencedomain.org/review-history/19561

Review Article

Received 1st April 2017
Accepted 27th May 2017
Published 16th June 2017

ABSTRACT

Hypertension is one of the major public health problems, prevalent all over the world. It is newly described as an iceberg disease, as the submerged portion of the iceberg represents the larger, hidden and undiagnosed portion of the disease. It is the leading risk factor for cardiovascular diseases and associated with cardiovascular morbidity and mortality globally. Non-adherence to recommended lifestyle is one of the several causes of uncontrolled hypertension. The possible modifiable risk factors include obesity, stress, physical inactivity, high salt diet, smoking, alcohol consumption and others. Lifestyle modification is non-pharmacological therapy that comprise dietary approaches to stop hypertension (DASH) diet, reduction of body weight among overweight, reduced alcoholic intake, smoking cessation, physical activity as recommended by WHO.

Adherence is a widespread problem in chronic conditions as hypertension, and is influenced by certain factors. These include; socioeconomic factors, health status of the individual, current therapy, cognitive factor, interpersonal relationship and personal factors. Adherence and lifestyle modification are inseparable measure and as such, public awareness has to be increased on lifestyle modification and importance of adherence emphasized. Understanding these factors can be useful in influencing the health behavior of the population. Motivational interview have shown positive results in improving adherence and participation of intended audience. This measure can be very effective when primary health care approach is applied.

**Corresponding author: E-mail: mirian_nkeiruka@yahoo.com;*

Keywords: Lifestyle modification; adherence; hypertension; control.

1. INTRODUCTION

Hypertension is one of the major public health problems and it is prevalent all over the world [1]. It occupies fourth place in the world by its prevalence. It is emerging as an important cause for morbidity and mortality in adults. It is an iceberg disease because unknown morbidity exceeds known morbidity [2]. Current data indicate that cases of hypertension seen in hospital are 'just a tip of the iceberg' [2]. The submerged portion of the iceberg represents the larger, hidden and undiagnosed portion of the disease. Hypertension also known as high blood pressure is the persistent elevation of blood pressure in the arteries [3]. Hypertension is defined as a systolic blood pressure (SBP) of 140 mm Hg or more, or a diastolic blood pressure (DBP) of 90 mm Hg or more, or taking antihypertensive medication [4]. Controlling hypertension in all patients with cardiovascular disease or stage 2 hypertension could be effective and cost-saving [5].

The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) [6] and recent guideline updates [7] identify lifestyle modifications as a critical first-line step to hypertension control. Recommended lifestyle modifications include: weight loss in overweight and obese individuals, adoption of the Dietary Approaches to Stop Hypertension (DASH) plan, dietary sodium reduction, physical activity, and moderation of alcohol intake. Lifestyle modifications are effective in improving hypertension control, reducing cardiovascular risk, and enhancing antihypertensive medication efficacy [8].

It is now known that the determinants of good blood pressure control in hypertensive patients are multi-factorial and the guidelines on the management of hypertensive patients are not based on medication adherence alone but also adherence with lifestyle modifications [9]. The benefits of adequate blood pressure control was reported to reduce the incidence of stroke by an average of 35% – 40%, myocardial infarction by 20% – 25% and heart failure by more than 50% [10]. With the modernization and adoption of western lifestyle habits in developing countries, it is likely that lifestyle related factors could predispose to poor blood pressure control in the region [9,11]. Country variation in the prevalence of hypertension may also be related to differences in the levels of urbanization and acculturation, diets, cultural habits and ethnicity [12].

Uncontrolled hypertension is commonly contributed by non-adherence to the recommended regimen, in order to prevent the complications of hypertension which are debilitating, and if not prevented can increase the burden of hypertension [13]. Poor adherence to long-term therapies severely compromises the effectiveness of treatment making this a critical issue in population health both from the perspective of quality of life and of health economics. Interventions aimed at improving adherence would provide a significant positive return on investment through primary prevention (of risk factors) and secondary prevention of adverse health outcomes [14].

From a clinical perspective, non-adherence can reduce treatment effectiveness and lead to relapses, complications, or even death [15]. Non-adherence carries a huge economic burden. Yearly expenditures for the consequences of non-adherence have been estimated to be in the hundreds of billions of US dollars [16]. In addition, higher hospital admission rates resulting from non-adherence increase the cost of medical care [15,17]. This paper is projected at explaining the lifestyle modifications appropriate for hypertension and factors that influence its adherence, to improve quality of life.

2. OVERVIEW OF HYPERTENSION

Hypertension confers the highest attributable risk to deaths from cardiovascular disease [18] and epidemiological data provide convincing evidence that the risk of cardiovascular disease related to blood pressure is graded and continuous [19]. This risk is evident even in childhood; with elevated blood pressure predicting hypertension in adulthood [20], and adverse effects of elevated blood pressure in childhood on vascular structure and function, specifically left ventricular hypertrophy, are already apparent in youth [19]. Reduction of blood pressure reduces this risk in people with and without hypertension and is a desired goal in children and adults [19].

2.1 Risk Factors of Hypertension

High blood pressure is caused by unknown and known causes [21]. There are two types of high blood pressure, primary hypertension and secondary hypertension. Primary hypertension, also known as essential hypertension is when the cause is unknown. It might result from unhealthy lifestyle and aging.

The following are modifiable risk factors: obesity, poor coping with stress, physical inactivity, high salt diet, smoking, alcohol consumption, poor dietary consumption and others.

2.1.1 Obesity

Obesity has reached an epidemic proportion worldwide with near double prevalence since 1980 [22,23]. In adults aged 20 years and above, the prevalence of obesity was reported as 11% [23]. It is equally interesting to note that obesity epidemic is growing faster in developing countries than in developed countries of the world [22,23,24]. This drastic change has been attributed to the impact of globalization by many authors [24,25].

Abdominal obesity though linked with cardiovascular diseases (CVDs) and some malignancies is socially acceptable amongst Nigerians and is therefore not usually recognized as a health risk [26]. Until recently and especially in the south-eastern part of Nigeria (where the index study was conducted), a protruding abdomen amongst men was seen as a sign of affluence and prosperity [26]. The net effect was for young adults who saw abdominally obese relations as role models to aim at gaining weight and accumulating fat in the abdomen. They were absolutely ignorant of the health implications of their actions. This negative perception would have been responsible for the increased prevalence of abdominal obesity reported by some studies carried out in Nigeria [27]. Globalization in Nigeria and its exponential negative impact on health has been linked to the increasing burden of abdominal obesity and a concomitant raise in the prevalence of hypertension.

The mechanism linking abdominal obesity with hypertension might be explained by the activation of the renin–angiotensin– aldosterone system which primarily leads to the activation of the sympathetic activity, promotion of the leptin resistance by increased procoagulatory activity. The cumulative effect of this cascade is endothelial dysfunction and inflammatory changes. Additional mechanism includes the enhanced renal sodium reabsorption with a resultant increase in volume expansion usually observed in abdominally obese patients [28].

A literature review found that the risk of adult obesity is at least twice as high for obese children as for non-obese children, as about a third of obese preschool children were obese as adults, and about half of obese school-age children were obese as adults [29]. Adults who have been obese as children may have an even greater prevalence of risk factors for CVD, including hypertension and dyslipidemia, compared with those who had normal weight as children. It has also been shown that childhood obesity and central adiposity increased the risk for the metabolic syndrome in adulthood [30].

Table 1 is the adult weight classification adopted from WHO (2000) Obesity: preventing and managing the Global Epidemic: Report on a WHO consultation on obesity [30].

Obesity and hypertension have become public health issues with rising prevalence globally, associated with increased morbidity and mortality from cardiovascular diseases as well as increased socio-economic costs [31]. The incidence and prevalence of obesity is rising in developing countries due to rapid unplanned urbanization and adoption of western lifestyles and reduced physical activity [32]. In developing countries, obesity often co-exists with under nutrition and affects virtually all age

Table 1. Classification of adult weight

Classification	Body Mass Index (BMI)	Risk for developing health problems
Underweight	Below 18.5	Increased
Normal weight	18.5-24.9	Least
Overweight	25.0-29.9	Increased
Obese		
Class I	30.0-34.9	High
Class II	35.0-39.9	Very high
Class III	Above 40.0	Extremely high

groups [32]. Obesity is a multi-factorial disorder in which both genetic and environmental factors have been implicated [33]. The key causes of obesity are reduced physical activity, increased consumption of foods high in sugars and saturated fats [33]. Obesity and weight gain have been reported to be the most significant determinants of hypertension [33,34].

2.1.2 Stress

Stress management has been considered to be a coadjutant therapy with pharmacological treatment and other lifestyle modifications in the management of hypertension [35]. Possible biological plausibility may reside in the effect of cortisol on hypertension [36]. A sub study from the Tockholm female coronary risk study was carried out to assess the effect of stress in coronary arterial diameter. After controlling for other factors the researchers found that stress was independently related to smaller diameter when evaluated by angiography which could mean that stress could accelerate coronary disease process in women [37]. There are slight differences across gender groups in the perception of stress and symptoms, with women's explanatory model placing more emphasis on family and men's model emphasizing work stressors [38]. Stress is commonly referred as a cause of hypertension [35]. Hence, stress management is seen as an effective way to control hypertension [39].

Recent reviews [40,41] have concluded that psychosocial stress is a major independent risk factor for hypertension, coronary artery disease, and cardiovascular mortality. Studies have shown that individuals who exhibit exaggerated cardiovascular responses to mental stress tasks are at increased risk for developing hypertension in subsequent years [42]. These experiments are particularly noteworthy because, whereas "stress" is often considered difficult to define and measure, the stress variables were under

Table 2. Risk factors of hypertension

Modifiable risk factors	Potentially modifiable risk factors	Non-modifiable risk factors
• High salt intake • Low potassium intake • Lack of physical activity • Obesity • Stress • Depression [44] • Caffeine consumption [45] • Vitamin D deficiency [46] • Events early in life Such as maternal smoking, low birth weight and lack of breast feeding [48] Secondary hypertension • Arsenic exposure through drinking water • Excessive eating of liquorice • Sleep apnea • Certain prescription medicines • Obesity • Pregnancy • Excessive drinking of alcohol • Illegal drugs • Herbal remedies [49]	• Insulin resistance [47] • Pheochromocytoma • Cushing syndrome • Hyperthyroidism, • Hypothyroidism • Acromegaly • Conn's syndrome • Hyperaldosterone • Hyperparathyroidism [49].	• Hereditary • Increasing age • Male gender • Race or ethnicity [47]

laboratory control. Cardiovascular responses represent plausible mediators between daily experience of stress and long-term impact on the cardiovascular system. Responses to acute stress are triggered through the sympathetic nervous system and the hypothalamic-pituitary-adrenocortical axis and increase cardiac output, heart rate, and peripheral resistance [42]. Chronic stress is believed to lead to chronically elevated BP levels through persistent hyperactivation of the sympathetic nervous system and hypothalamic-pituitary-adrenocortical axis [41,43].

The Table 3 is a unified table of possible risk factors to hypertension, of which so many are attributed to modifiable risk factors.

2.2 Lifestyle Modification

Lifestyle is referred to an individual's healthy and unhealthy behaviors that can have impact on their health status. A healthy promoting lifestyle is one in which self-initiated, continuous, daily activity is undertaken with the deliberate aim of increasing or promoting an individual's health and wellbeing [50]. Studies have revealed that the most important health risk factors include poor diet, inactivity and low physical inactivity, as well as smoking which are the main factors for an individual's lifestyle, and 80% of heart diseases could be avoided by making changes in these factors [50].

Lifestyle modification also known as non-pharmacological therapy is the cornerstone of helping out hypertensive patients to attain lifestyle behaviors that are healthy [51]. It is recommended that a healthier lifestyle is essential in order to minimize hypertension risk with a combination of antihypertensive drugs [52]. Lifestyle change is an effective way of managing high blood pressure [53]. It is also said that lifestyle change may delay hypertension and even prevent it [54].

BHS guidelines state that advice should be provided for prevention as well as treatment of hypertension and should be given to pre-hypertensive and those with strong family history. They point out that effective lifestyle modification can lower blood pressure by at least as much as a single antihypertensive drug [55]. Even a 2mmHg decrease in diastolic blood pressure has been found to reduce hypertension prevalence by 17%, risk of coronary heart disease by 6% and stroke by 15% [55].

It also pointed that these interventions can reduce the need for drug therapy, enhance the effect of antihypertensive drugs, reduce the need for multiple drug regimens, and favorably influence overall cardiovascular risk [56].

2.2.1 Dietary approach to stop hypertension (DASH) diet

The Dietary Approaches to Stop Hypertension (DASH) diet is low in sodium and high in potassium, magnesium and calcium [57]. DASH is a carbohydrate-rich eating plan that emphasizes increasing consumption of fruits, vegetables, and low-fat dairy products and reducing the consumption of saturated fat, total fat, and cholesterol by decreasing consumption of red meat, sweets, and added sugars. The dietary approaches to stop hypertension (DASH) diet recommends lots of fruits and vegetables, low-fat dairy products, low in total fat, saturated fat and cholesterol [58]. DASH diet has produced effective results in lowering hypertension [21]. High dose (at least 3 g/day) omega-3 polyunsaturated fatty acid supplement (fish oil) may also lower blood pressure in hypertensive individuals [59]. It is necessary to avoid or limit intake caffeine (colas, coffee, tea, chocolate and some energy and weight loss drinks). Read food labels [60], and choose products that are low in sodium (<120 mg Na/100 g), low in fat (<3.0 g/100 g) in solid products and <1.5 g/100 g in liquids, low in saturated fats, and contain no Trans-fats. It is also important to keep total fats to below 15-30% of total energy. Maximum fat intake levels should be: <70 g/day for females and <95 g/day for males of normal weight, and <50 g/day for females and <70 g/day for males who are overweight [60]. There are protective factors against cardiovascular health like eating fruit and vegetables in only 5.5% of the hypertensive population of study [61].

The World Health Organization recommends a reduction in sodium intake of less than 2 grams per day to reduce hypertension and the risk of developing a cardiovascular disease independently of age [3]. It is recommended that patients avoid salt added to food and high salty food [62]. Reducing dietary sodium by approximately 1700 mg (75 mmol) per day can lower systolic blood pressure by 4-5 mmHg in hypertensive individuals and 2 mmHg in normotensive individuals [63,64]. This may reduce the need for antihypertensive drugs. Responses vary between individuals and are generally greatest among the elderly and those

with severe hypertension. Reduced salt diets in combination with thiazide diuretics may predispose elderly patients to hyponatraemia so electrolytes should be monitored regularly [65].

Some clinical trials suggest that increasing dietary potassium by approximately 2100 mg (54mmol) per day can reduce systolic blood pressure by 4-8mmHg in hypertensive individuals and 2mmHg in normotensive individuals. Potassium-rich whole foods, such as bananas, kiwi fruit, avocado, potatoes (with skin), nuts and yoghurt, are more effective in reducing blood pressure than potassium supplements, which is more effective in reducing blood pressure than potassium supplements, which are potentially toxic [63]. High potassium intake can produce hyperkalaemia in people with impaired renal function. It should be recommended only for those with known normal renal function [63].

The eating plan below is from the "Dietary Approach to Stop Hypertension" (clinical study) supported by the National Institute of Health.

Table 3. DASH diet

Food group	Daily servings	Serving sizes	Examples	Significance of each food group to the DASH diet pattern
Grain and grain products	7-8	1 sliced bread, 1C dry cereal, ½C cooked rice, pasta or cereal	Whole wheat bread, cereals, grits and oatmeal	Major sources of energy and fiber
Vegetables	4-5	1C raw leafy vegetable, 1/2C cooked vegetable, 6oz vegetable juice	Tomatoes, potatoes, carrots, peas, squash, turnip greens, spinach, beans and sweet potatoes	Rich source of potassium, magnesium and fiber
Fruits	4-5	6oz fruit juice, 1 medium fruit, 1/4C dried fruit, 1/2C fresh frozen or canned fruit	Apricots, bananas, dates, grapes, orange juice, grape, juice, mangoes, melons, pineapples, tangerines, strawberry	Important sources of potassium, magnesium and fibre
Low fat or non dairy foods	2-3	8oz milk, 1C yogurt, 1.5oz cheese	Skim or 1% milk skim or low fat, buttermilk, nonfat or low fat yogurt, non fat cheese	Major sources of calcium and potassium
Meat, poultry and fish	2 or less	3oz cooked meats, poultry or fish	Select only lean, trim away visible fats, broil, roast or boil, instead of frying, remove skin from poultry	Rich sources of protein and magnesium
Nuts, seeds and legumes	4-5 per week	1.5oz or 1/3C nuts, 1/2 oz or 2Tbsp seeds, 1/2C cooked dry beans	Almonds, mixed nuts, peanuts, walnuts, lentils, peas, kidney beans, filberts	Rich sources of energy, magnesium, potassium and fiber
Fats and oils	2-3	1 tsp soft margarine, 1 Tbsp low fat mayonnaise, 2Tbsp light salad dressing, 1tsp vegetable oil	Soft margarine, low fat, mayonnaise, light salad dressing, vegetable oil (such as olive, canola or sufflower)	Besides fats added to food, remember to choose foods that contain less fats
Sweets	5 per week	1 Tbsp sugar, 1 Tbsp jelly or jam, 1/2 oz jelly beans, 8oz lemonade	Maple syrup, sugar jelly jam, fruit, flavored gelatin, ices, hard candy	Sweets should be low in fat

Dietary approach to stop hypertension (DASH) [66]

The following are the advantages of DASH diet:

DASH found that a diet low in fat and high in vegetables, fruits, fiber, and low-fat dairy products significantly and quickly lowers blood pressure. The diet was tested without changes in weight, or sodium or alcohol consumption [67]. DASH investigators believe that a "combination diet" low in total fat, saturated fat, and low-fat dairy products, which results in specific increases in fiber, protein, potassium, magnesium and calcium with moderate salt content, reduce systolic blood pressure by an average of 5.5 mmHg and diastolic by an average of 3.0 mmHg. the fruit and vegetables reduce blood pressure by 7.2/2.8 mmHg for hypertensive. Hence, the combination diet if added to current lifestyle recommendations, could prevent hypertension, reduce and possibly eliminate the need for medication in those who already have the condition.

TONE found that weight loss and reduction of dietary sodium safely reduce the need for antihypertensive medication in older patients, while keeping their blood pressure under control [67].

The International guidelines [6,68] advocate diet/behavioral modification at every stage, both before drug therapy in pre-hypertension or uncomplicated stage one hypertension as well as for high risk patients and those on modification. The DASH diet has been found to lower weight, heart rate, risk of type 2 diabetes, C-reactive protein, apolipoprotein B and homocysteine and is associated with a lower incidence of heart failure, all-cause mortality and stroke [69,70].

The Premier trial found that the DASH diet combination with alcohol and salt reduction, weight loss and aerobic exercise achieved a reduction of 14.2/7.4 mmHg among hypertensives, while hypertension prevalence fell over a period of six months from 38% to 12% [71].

The BHS and International guidelines advocate diet and behavioral modification with all patients regardless of weight, severity of hypertension or intake of medication. The advantages include a significant drug cost reduction, a beneficial effect on other conditions such as diabetes and hypercholesterolemia, and avoidance or delay of drug treatment with its potential for adverse effects [55,68].

2.2.2 Reduction of body weight

According to [62], excess body weight has a major impact on high blood pressure hence losing weight is an essential way of managing and preventing high blood pressure. Maintenance of normal body weight plays a large role in prevention and reduction of high blood pressure [72]. For patients who cannot maintain normal body weight, losing at least 4.5 kg is a fair start towards lowering high blood pressure [72]. Being overweight not only does it elevate blood pressure, it also increase risks of having diabetes. Proper weight loss plan includes exercises and good nutrition. Therefore it is important to get a 30 minute workout at least 5 days a week [62]. There is a direct association between blood pressure and body weight and/or abdominal adiposity. Every 1% reduction in body weight lowers systolic blood pressure by an average of 1 mmHg [63]. Losing 4.5 kg reduces blood pressure prevents hypertension in a large proportion of overweight people, while losing 10 kg can reduce systolic blood pressure by 6-10 mmHg [63]. In overweight patients with hypertension, weight-reducing diets can achieve a 3-9% decrease in body weight and may reduce systolic and diastolic blood pressure by approximately 3 mmHg.

2.2.3 Reduction of alcoholic intake

Alcohol use was found to have a direct relationship with the development of hypertension. The effects on individuals blood pressure was dose dependent. Those who were heavy consumers exhibit greater variation in their blood pressure with the least consumers having milder effects [73]. Alcohol intake was associated with the increase in both systolic and diastolic blood pressure [74]. This was further reinforced through a cohort study, in which those who consumed two or more drinks of alcohol a day had a high risk of developing hypertension [75]. Evidence for cardiovascular benefits of light drinking has been challenged by a recent meta-analysis [59]. Regardless of this debate, evidence is emerging that all levels of alcohol intake increase blood pressure. Moderate drinking can increase the risk of hypertension [63]. Epidemiological data show a linear relationship between alcohol consumption and hypertension prevalence [59]. Reducing alcohol consumption can lower systolic blood pressure by an average of 3.8 mmHg in patients with hypertension [76]. The heart foundation recommends that patients with hypertension limit

their alcohol intake to a maximum of two standard drinks per day for men, and one standard drink per day for women [63].

2.2.4 Smoking cessation

Evidence shows that smoking is one of the risk factors known to cause hypertension [62]. Smoking has great effects to the heart and blood pressure. It causes damage to the lining of the artery walls, which causes narrowing to the arteries, hence rising blood pressure. Smoking also causes other risky disease such as heart disease, stroke and heart attack. Hypertensive patients who smoke are at higher risk of having heart attack, stroke and other cardiovascular diseases compared to non-smokers with hypertension. Smoking produces toxic chemicals able to decrease blood oxygen levels, to generate oxidant species and to increase arterial wall thickness, eventually resulting in heightened blood pressure [62]. Smoking is a strong independent risk factor for cardiovascular disease. People who smoke show higher ambulatory blood pressure levels than non-smokers [59]. Smoking may be hard to quit but with proper guidance from health care personnel's, it can be done easily. Nicotine replacement therapies increase the chances of stopping smoking by 50-70% [77]. Numerous programs on how to quit smoking are available, with varying success rates.

2.2.5 Physical activity

Lack of physical activity is an important contributor of the higher incidence and increased prevalence of obesity, hypertension and cardiovascular diseases in this population [78]. Sedentary lifestyle is defined as a type of lifestyle where an individual does not receive regular amount of physical activity [79]; 60 to 85% of the population worldwide does not engage in enough activity. This makes physical inactivity the fourth leading risk factor for global mortality. Physical activity as defined by WHO, is any body movement produced by skeletal muscles that require energy expenditure, including activities undertaken while working, playing, carrying out house hold chores, travelling, and engaging in recreational pursuits. It should not be confused with exercise which is a subcategory of physical activity that is planned, structured, repetitive and aims to improve or maintain one or more components of physical fitness. Physical inactivity is a modifiable risk factor for hypertension. It is important for people with hypertension to be fit in order to keep their blood pressure low [80]. Physical exercises should be done regularly for prevention and treatment of hypertension. Activities such as aerobic dancing, biking, walking and sports are recommended for at least half an hour per day [62]. Overweight patients are at higher risk of developing hypertension; hence weight reduction is highly advised [21]. Low intensity workouts are a good start for losing weight and being fit. Hypertensive patients especially those who are overweight and obese are advised to exercise 5-7 days a week. Aerobic physical exercises have great impact on reducing systolic blood pressure and diastolic blood pressure by 64 mmHg points for hypertensive patients [62].

The following physical activity is recommended [79]:

- **Children and adolescents aged 5-17 years:** Should do at least 60 minutes of moderate to vigorous-intensity physical activity daily, physical activity of amounts greater than 60 minutes daily will provide additional health benefits and should include activities that strengthen muscle and bone, at least 3 times per week.
- **Adults aged 18–64 years:** Should do at least 150 minutes of moderate-intensity physical activity throughout the week, or do at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity; for additional health benefits, adults should increase their moderate-intensity physical activity to 300 minutes per week, or equivalent and Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.
- **Adults aged 65 years and above:** Should do at least 150 minutes of moderate-intensity physical activity throughout the week, or at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity; for additional health benefits, they should increase moderate-intensity physical activity to 300 minutes per week, or equivalent; those with poor mobility should perform physical activity to enhance balance and prevent falls, 3 or

more days per week; muscle-strengthening activities should be done involving major muscle groups, 2 or more days a week.

The intensity of different forms of physical activity varies between people. In order to be beneficial for cardio-respiratory health, all activity should be performed in bouts of at least 10 minutes duration.

The following are benefits of physical activity to blood pressure control:

When individuals were stratified according to how their fitness levels changed, those who maintained or improved fitness had a 26% and 28% lower risk of incident hypertension, respectively, compared with those who lost fitness [81]. The *2008 Physical Activity Guidelines for Americans* state that 'For most health outcomes, additional benefits occur as the amount of physical activity increases through higher intensity, greater frequency, and/or longer duration [82]. A 2010 systematic review critically examined whether this dose-response relationship exists for the primary prevention of hypertension [83]. A total of 12 articles were identified, with all studies demonstrating a positive effect of physical activity on the risk for hypertension.

Two large studies in 2013 have further explored the dose-response relationship between physical activity and incident hypertension. In the Australian Longitudinal Study on Women, Pavey and colleagues showed that the risk for incident hypertension decreased with increasing total volume of physical activity [84]. The decreasing risk of hypertension was similar among women who engaged in only moderate physical activity and women who engaged in both moderate and vigorous physical activity at all volumes of MET equivalent physical activity with the exception of the highest volume of physical activity (>2000 MET minutes/week; 4 times greater than physical activity guidelines). Investigators concluded that a dose-response relationship for total volume of physical activity and incident hypertension exists, but that the addition of vigorous physical activity does not provide additional benefits in the prevention of hypertension above those from moderate intensity activity, except at very high volumes of physical activity.

Similarly, using data from the National Runners' Health Study II and the National Walkers' Health Study, Williams and Thompson found that running and walking were associated with comparable risk reductions of incident hypertension when equivalent energy expenditures (MET hours/day) were compared [85]. There were incremental reductions in risk for incident hypertension with greater MET hours/day for both modes of exercise. This dose-response relationship was similar in both the walking and running groups, suggestive that exceeding current guidelines in terms of energy expenditure incurs greater health benefits, regardless of intensity. A caveat to these findings is that substantially fewer walkers than runners exceeded physical activity guidelines for energy expenditure (450–750 MET minutes/week [86]) by 2-fold, (15.4% vs. 61.1%), 3-fold (4.5% vs. 40.1%), and 4-fold (1.1% vs. 17.9%). This finding was attributed to the fact that running expends more calories in a given period of time compared to walking. Thus, it could be argued that more vigorous exercise may indeed confer greater health benefits in that greater caloric expenditure can be achieved in an allotted time.

In 2013, Corenlissen and Smart conducted an updated meta-analysis examining the effects aerobic, resistance, and combined aerobic and resistance training on BP in randomized controlled trials [87]. Among prehypertensives, the effect of aerobic exercise training on BP was significant for systolic and diastolic BP, with net reductions of 4.3 mmHg and 1.7 mmHg reported, respectively. Among normotensives, the effect of aerobic exercise training on BP was significant only for diastolic BP as a net reduction of 1.1 mmHg was reported. In a separate meta-analysis, Cornelissen and colleagues investigated the effect of aerobic exercise on daytime and nighttime BP derived from ambulatory BP monitoring [88]. Significant reductions in daytime BP were observed in normotensives (daytime ambulatory BP <135/85 mmHg) when data from 11 randomized controlled trials were pooled, with net reductions of 2.2 mmHg for systolic BP and 3.3 mmHg for diastolic BP reported. No effect was observed for nighttime BP.

Also in 2013, Huang et al. conducted a meta-analysis investigating the effects of aerobic exercise training among elderly adults [89]. Pooling 23 studies, the net changes in systolic and diastolic BP were statistically significant and represented a net decrease of 5.3 mmHg and 3.7

mmHg, respectively. Four of the 23 studies included participants with hypertension; however investigators reported that results were similar when data were stratified according to hypertension status.

Walking-based interventions that encompass the accumulation of daily step count goals (e.g.10,000 steps/day) are analogous to interventions designed to increase daily physical activity levels. Evidence regarding whether the accumulation of steps over the course of a day may be beneficial for reducing BP is still limited. A meta-analysis of pedometer-based interventions pooled data from 12 studies totaling 468 participants who were mostly normotensive showed significant net reductions in systolic and diastolic BP of 3.8 mmHg and 0.3 mmHg, respectively [90].

In 2011, Cornelissen and colleagues conducted a meta-analysis on the BP lowering effects of resistance training [91]. Pooling data from 28 randomized controlled trials, resistance training resulted in a net decrease of 3.9 mmHg and 3.9 mmHg for systolic and diastolic BP, respectively, in normotensive/pre-hypertensive participants.

2.2.6 Stress reduction programs

It has been suggested that therapies such as relaxation, meditation, or biofeedback may help patients to reduce the effects of stress by reducing physiologic arousal and restoring autonomic balance, thereby reducing blood pressure [92].

Relaxation therapies aim to enable patients to achieve physical and mental relaxation. Examples include progressive muscle relaxation, using exercises to tense and release muscle groups [93] and autogenic training, which involves concentrating on somatic sensations and using autosuggestion [94]. Frequently, these therapies are combined with use of mental imagery or breathing exercises.

Meditation practices aim to cultivate a state of inner awareness and calm [95]. The most widely researched form is the Transcendental Meditation (TM) technique [95]. It is described as a unique and effortless process of taking the attention to successively finer states of a thought, until thought is transcended and the mind experiences pure awareness [96]. Instruction requires a qualified teacher who is certified through Maharishi Vedic Education Foundation [97]. Other meditative practices usually involve a form of contemplation or concentration and include mindfulness meditative practice [98]. Some mind-body practices, such as tai chi and qi gong, include meditative elements [95] but also involve significant exercise training effects and are usually categorized as forms of exercise [76].

Biofeedback involves use of electronic devices to monitor information on physiologic indicators of states of relaxation, such as muscle tension, skin temperature, skin conductance levels, or blood pressure. There are two major biofeedback categories: simple biofeedback (ie, as a standalone therapy), and relaxation-assisted biofeedback (ie, biofeedback plus relaxation training) [99].

Stress management training involves modification of psychologic and behavioral responses to stress. Psychologic approaches include cognitive restructuring and adaptive learning. Often these approaches are combined with relaxation training [100].

Linden and Moseley examined seven meta-analyses on stress reduction programs and hypertension. The authors of this review concluded that stress reduction programs yield reliable decreases in systolic BP of 6 to 10 mm Hg, with slightly larger BP reductions for multi-component interventions for patients on treatment [92].

Of the various lifestyle interventions, physical activity and dietary intervention have been shown to diminish the blood pressure and reduce CVD events, which have emerged as the two most effective and physiologically desirable approaches. That is why we defined that the multiple lifestyle changes should at least include physical activity and dietary intervention [101].

Table 4 is a summary of recommended lifestyle from the seventh Report of Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure [102].

2.3 Adherence and Quality of Life

Since HBP is a chronic condition with potentially serious outcomes, it has impacts on the quality of life of patients. Moreover, the undesirable effects of antihypertensive drugs may also interfere with the quality of life of patients and lead to a limited therapeutic adherence [102]. In addition, effects

Table 4. Recommended lifestyle

Modification	Recommendation	Approximate systolic blood pressure reduction
Weight reduction	Maintain normal body weight (BMI 18.5-24.9 kg/ m^2)	5-20 mmHg/10 kg
Adopt DASH eating plan	Consume a diet rich in fruits, vegetables and low-fat dairy products with a reduced content of saturated and total fat.	8-14 mmHg
Dietary sodium reduction	Reduce dietary sodium intake to no more than 10 mmol per day (2.4 g sodium or 6 g sodium chloride).	2-8 mmHg
Physical activity	Engage in regular aerobic, physical activity such as brisk walking (at least 30 minute per day, most day of the week).	4-9 mmHg
Moderation of alcohol consumption	Limit consumption to not more than 2 drinks per day in most men and to not more than 1 drink per day in women and lighter weight persons.	2-4 mmHg
Tobacco	Total abstinence	-

of the disease itself on the quality of life can generate emotional impacts on people's lives, and make them give up the medication, see no reasons for medication intake, do not realize advances in treatment, think a lot about the limitations or do not realize improvement in their behavior. Therefore, it is easy to notice the complex interaction between quality of life in hypertensive patients and medication adherence, which should be better understood by health professionals [103]. An adequate approach to hypertensive patients should consider the characteristics of each individual and their blood pressure levels, and the implications of the disease and its treatment on the quality of life. These are the individuals' perceptions about the conditions in which they live within a context of multiple dimensions in relation to their goals and expectations [104,105].

The adequate management of hypertensive patients should evaluate the characteristics of each individual, taking into account the blood pressure levels, and the implications of the disease and its treatment in their lives (and quality of life). These guidelines are based on the fact that just a small fraction of the hypertensive population has high blood pressure alone. The vast majority has additional risk factors such as dyslipidemia, smoking, diabetes, and others [106]. The grouping of cardiovascular risk factors in hypertensive patients is very common, and 80% of them have one or more associated conditions. The combination of HBP with these factors results in a higher risk of developing cardiovascular disease than the sum of the individual factors [106,107].

Importantly, in addition to drug treatment, people living with hypertension should also adhere to a lifestyle with habits of weight control, diet with salt restriction, smoking cessation and physical activity practice [108]. Data from this study indicate the adoption of such habits by a large portion of the group, but many individuals have BMI (body mass index) above recommended. The poor correlation between quality of life and medication adherence reinforces the idea of a relationship between quality of life and several factors not limited only to medication adherence [107].

2.4 Adherence and Lifestyle Modification

Adherence can be defined as “the extent to which a patient acts in accordance with the prescribed interval and dose of a dosing regimen” [109]. Non-adherence is a widespread problem in chronic conditions [110]. Adherence is a multi-factorial problem that can be influenced by various factors. These factors are divided into five dimensions: Social and economic, health care system, health condition, therapy and patient [14].

2.4.1 Socioeconomic factors and adherence

The Agency for Health Research and Quality [111] indicated that low adherence was due to poor social status of the patient. It also pointed

out that poor economic status was responsible for low adherence level. High cost of treatment and transport affects the adherence [112]. Low income is an important factor in treatment adherence [113].

The bibliographic survey revealed that, among the various factors related to the patient, low economic status plays a crucial role in the treatment adherence of hypertensive patients, as well as cultural factors, access to health services, and level of knowledge concerning the disease [114].

A study submitted that married participants were more compliant with treatment (61%) than non-married participants [115]. Studies suggest that various barriers including unsafe neighborhoods to be active, lack of community involvement, economic limitation, lack of motivation to exercise and busy daily lives are contributing factors to the physical inactivity [116].

2.4.2 Health condition and adherence

Evidence shows that patients with other underlying chronic illness tend to have poor adherence. For example, patients with conditions that do not show signs and symptoms are less motivated to observe compliance recommendations [112]. It was also found that poor health is related to non-adherence, but only for patients who face serious health conditions [117].

Patients that suffer from depression and other mental disorders are linked to poor treatment adherence [117]. Lack of symptoms and the chronic nature of the disease were the reasons reported by the patients for therapeutic failure and abandonment of medications, according to a study conducted in Teresina [105].

2.4.3 Therapy and adherence

Studies showed that treatment approaches which interfere with the patient's daily routine tend to have low adherence rates. Long treatment regime is also associated with adherence failure [118]. It has been pointed out that treatment side effects can also have negative influences on adherence [112,119]. Long treatment regime with lack of immediate effectiveness was linked with treatment default. America College of Preventive Medicine suggested the need for simplified treatment modalities which will suit the patient's own daily activities [120]. Suggestion was made that the caregivers should counsel and advice the patients on the importance of the behavior change. Waiting time was reported by study participants as a factor that interferes in treatment adherence [113]. Also, the time patients spent in consultations, duration of therapy and therapeutic scheme influences patient behavior [121].

2.4.4 Cognitive factor

McCarley affirmed that adherence to treatment approaches by patient is more likely only if the patient understands the need for the behavior modification [122]. Patients who are well informed about their treatment approach were able to make decisions and set informed goals with the hope of having the bright future [123]. From the studies conducted by Tsay & Hung, patients who were empowered exhibited considerable improvements in behavior change and self-care in general [124]. Patients understanding their drug regimens help to improve compliance to treatment thereby preventing complications of hypertension and the debilitating outcomes [125].

A vast body of research has studied how cognitive processes predict adherence behaviors. It appears that cognitive factors are better predictors of adherence than personal characteristics [126]. It has been shown that patients who believe that the treatment can have some benefits [127], a disease can have serious consequences [117,128] and those who have a positive attitude toward the treatment and have more knowledge about diseases or health in general [129] adhere more to doctors' prescribed treatment regimens. Conversely, perceived barriers [127], side-effects [127]; and perceived health status appear to be negatively related to adherence. DiMatteo and her colleagues also found that poor health is related to non-adherence, but only for patients who face serious health conditions [117].

2.4.5 Interpersonal factors

Studies indicated that families play a crucial role in treatment adherence [113]. Families offer encouragement and motivation needed for behavior change. Likewise, peer groups proved to be one of the effective ways to offer support and sense of hope to the patients [128]. Family provides reinforcement to behavior change. Patients who came from unsupportive families were associated with poor compliance [111].

One aspect of participants' interpersonal relationships that appears to have a consistent influence on adherence is social support [129, 130]. The quality of interpersonal relationships is more important than the quantity of relationships in predicting adherence [131]. DiMatteo reported that family conflicts are related to poor adherence [132]. A few researchers examined the impact of peer-pressure on medical adherence. Peer-pressure predicts patients' intention to adhere to prescribed treatments, which in turn influences adherence to lifestyle changes [133]. The use of pressure and persuasion strategies by spouses has also been linked to greater adherence [134]. However, another group of researchers reported that when friends and family members have strong opinions about asthma patients' medication use, patients were less likely to take their medications [135].

2.4.6 Positive relationship with care providers and adherence

The quality of patient care provider has greater effects on adherence [113]. Patient care giver relationship which included encouragement, reinforcement and understanding exhibited high rates of adherence. Studies found out that nurses and other health professionals played an important role in empowering the clients with important information with regards to treatment adherence and lifestyle modification [124]. Although it is the responsibility of the healthcare team to make recommendations on behavior change, studies showed that patients should take active role when it comes to lifestyle changes rather than being forced to adhere to changes formulated by others [126]. Providers may not be familiar with the guidelines for hypertension management and the manner in which providers view their relationship with their patients will influence their approach to sharing information and responding to the needs articulated by the patient [124].

2.4.7 Motivational interview and adherence

Motivation plays an important role in treatment adherence [14]. The values and beliefs held by the patients towards the treatment approach are directly proportional to the treatment adherence. Therefore, motivated patients are ready to follow the treatment guidelines. Studies have shown that motivational interviews facilitate engagement between the care provider and the patient thereby fostering empowerment [122]. Furthermore, studies on patients with chronic illnesses have shown positive results after motivational interview. These include coping mechanisms, lifestyle modification and psychological stability [136]. Through motivational interviews, patients had opportunity to raise concerns about their planned management and proposed behavior change [137]. He further explained that patients were able to give reasons as to why they supported or resist the planned behavior change. With the help of health professionals, patients were to understand what was conflicting with the set objectives how the how the current lifestyle. For example they had to argue out their reasons for supporting or going against the proposed behavior change.

It was the responsibility of the health professionals to offer guidance and to facilitate [138]. Failure can be attributed to time constraints, fatigue, cost, and a lack of motivation to make changes; prior data demonstrates that about 50% of patients have difficulties implementing diet and exercise [139,140].

2.4.8 Patient and adherence

Patients' feelings and beliefs of wellness can impact adherence to physician recommendations of daily medication and lifestyle changes [141]. In a study majority 63 (63%) hypertensive patients have noncompliance and 37 (37%) has compliance regarding life style modifications [142]; it showed a relationship between age and lifestyle compliance. 36-75 years hypertensive patients were more compliant with lifestyle modification than 26-35 years. The study finding also depicts that there was a relationship between duration of hypertension and lifestyle compliance among hypertensive patients. They further reported that hypertensive patients with more than 3 years duration had more compliance to lifestyle modification when compared with those that had a shorter duration of the illness. This corresponds with the study carried out in Mazowe district, Zimbabwe in which, there was a high prevalence of non-compliance with recommended lifestyle modifications among patients with duration less than 3 years [143].

The health belief model can be utilized to influence the populace, towards a positive lifestyle.

3. CONCLUSION

Hypertension is a major public health problem, with cases seen in the hospitals as just a tip of

the iceberg [1,2]. It is one of the most common causes of disability and death amongst adults. Studies have shown that unhealthy lifestyles such as physical activity, smoking, heavy alcohol use, and high salt diet as well as others have been identified with difficult blood pressure control [108,43,104,45].

Lifestyle modifications are indispensible and as such should be made known to the public especially to people in the rural settings and developing nations, irrespective of their blood pressure readings. This is due to the submerged portion of the iceberg disease. Adherence and lifestyle modifications are inseparable and as such, adherence must be enforced to achieve a positive result. Understanding these factors, can be useful in influencing the health behavior of the population. Public awareness has to be increased on lifestyle modification and the importance of adherence emphasized, in order to reduce morbidity, mortality and cost of health care. Also, misconceptions about hypertension control can be corrected through appropriate enlightenment.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Pethuru D, Sabarinath M, Reshma DR, Sameena A, Sanjeetha FS, Mathiarasu AM. Risk factors for hypertension and its complications – A hospital based case control study. International Journal of Interdisciplinary and Multidisciplinary Studies (IJIMS). 2014;1(4):160-163.
2. Nwachukwu DC, Agu UF, Nwachukwu NZ. Pattern of renal impairment among hypertensive subjects in Umuahia, South East, Nigeria. Int. J. Med. Med. Sci. 2016; 8(5):45-50.
3. WHO. World health statistics 2012 report: increase of hypertension and diabetes; 2012. (Accessed online on 21st December, 2016) Available:http://www.euro.who.int/en/health-topics/noncommunicable-diseases/diabetes/news/news/2012/5/world-health-statistics-2012-report-increase-of-hypertension-and-diabetes
4. Roger VL, Go AS, Lloyd-Jones DM, Benjamin EJ, Berry JD, Borden WBC. Heart disease and stroke statistics – 2012 update: A report from the American Heart Association. Circulation. 2012;125(1):e2-e220.
5. Moran AE, Odden MC, Tharutaveerat A, Tzong KY, Rasmussen PW, et al. The cost effectiveness of hypertension therapy according to 2014 guidelines. N. Engl J. Med. 2015;372:447-455.
6. Chobanian AV, Bakris GL, Black HR. The National High Blood Pressure Education Program Co-ordinating Committee, The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. The JNC 7 Report. JAMA 2003; 289: 3560-3572.
7. Mungal-Singal V. Lifestyle changes for hypertension. South Africa Family Practice 2012;54(2):S12- S16.
8. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LW, et al. Clinical practice guidelines for the management of hypertension in the community: A statement by the American Society of Hypertension and the International Society of Hypertension. J Clin Hypertens. 2014; 16:14–26.
9. Johnson HM, Olyson AG, Lamanti JN, Kind AJH, Pandhi R, et al. Documented lifestyle education among young adults with incident hypertension. J. Gen Intern Med. 2015;30(5):556-564.
10. Iloh GUP, Ofoedu JN, Njoku PU, Amadi AN, Godswill-Uko. Medication adherence and blood pressure control amongst adults with primary hypertension attending a tertiary hospital primary care clinic in Eastern Nigeria. African Journal of Primary Health Care and Family Medicine. 2013; 5(1):446-452.
11. Neal B, MacMahon S, Chapman N. Blood pressure lowering treatment trialists' collaboration: Effects of ACE inhibitors, calcium antagonists and other blood pressure lowering drugs: Results of prospectively designed overviews of randomized trials. Lancet. 2000; 356(9246):1955-1964.

12. Iloh GUP, Chuku A, Obiegbu NP, Ofoedu JN, Ikwudinma AO. Frequency of cardiovascular risk factors in adult Nigerians with family history of non-communicable cardiovascular disease in a primary care clinic of a tertiary hospital in a resource-constrained environment of Eastern Nigeria. American Journal of Health Research. 2013;1(1):17-25.
13. Ogah OS, Rayner BL. Recent advances in hypertension in sub-Saharan Africa. BMJ. 2013;1:8-10.
14. Kumar P, Halesh LH. Antihypertensive treatment: A study on correlates of non adherence in a tertiary care facility in Mahrous FM. Factors affecting Compliance of hypertensive patients toward therapeutic regimen. Int J Biol Med Res. 2010;1(4): 248-252.
15. WHO: Adherence to long-term therapies: Evidence for action Geneva in Mahrous FM. Factors affecting compliance of hypertensive patients toward therapeutic Regimen. Life Science Journal. 2003; 12(10):62-69.
16. Cutrona SL, Choudhry NK, Stedman M, Servi A, Liberman JN, et al. Compliance and beliefs about medicines taking into account the ordered categorical structure of data. Journal of Evaluation in Clinical Practice. 2010;15:713-723.
17. Leslie RM, Summer LW, Haskard KB, DiMatteo MR. The challenge of patient adherence. Ther Clin Risk Manag. 2005; 1(3):189-199.
18. Bondesson A, Hellström L, Eriksson T, Höglund P. A structured questionnaire to assess patient and beliefs about medicines taking into account the ordered categorical structure of data. J Eval Clin Pract. 2009; 15(4):713-723.
19. Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: Systematic analysis of population health data. Lancet. 2006;367(9524):1747-57.
20. Chattopadhyay A, Taraphdar P, Kumar Sahu B, Maulik S, Ghosh R, et al. A study on prevalence of Hypertension and its related risk factors among undergraduate medical students in Kolkata. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2014;13(11):1-7.
21. Ingelfinger JR. Pediatric antecedents of adult cardiovascular disease- awareness and intervention. N Engl J Med. 2004; 350(21):2123-2126.
22. Eskridge MS. Hypertension and chronic kidney diseases: The role of lifestyle modification and medication management. Nephrology Nursing Journal. 2010;37(1): 56 57.
23. Grotto I, Grossman E, Huerta M, Sharabi Y. Prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli adults. Hypertension. 2006;48:254-259.
24. Kearney PM, Whelton M, Reynolds K, Munter P, Whelton PK, et al. Global burden of hypertension: Analysis of worldwide data. Lancet. 2005;365:217–223.
25. Ogah OS, Okpechi I, Chukwuonye II, Akinyemi JO, Onwubere BJC, et al. Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans. A review. World J Cardiol. 2012;4:327-340.
26. Alwan A. Global status report on non-communicable diseases 2010. Geneva, Switzerland: World Health Organization; 2010.
27. Ojji DB, Alfa J, Ajayi SO. Pattern of heart failure in Abuja, Nigeria: An echocardiographic study. Cardiovasc J Afr. 2009;20:349- 352.
28. Asafa MA, Ogunlade O. Prevalence of high blood pressure among young adults in Ile-Ife, Nigeria. International Journal of Analytical, Pharmaceutical and Biomedical Science. 2015;4(2):69-73.
29. Iloh GUP, Amadi AN, Ikwudinma AO, Njoku PU. Prevalence and family biosocial predictors of abdominal obesity among adult Nigerian Africans in a resource constrained setting of a rural hospital in Eastern Nigeria. European Journal of Preventive Medicine. 2013;1:70-78.
30. Serdula MK, Ivery D, Coates RJ, Freeman DS, Williamson DF, Byers T. Do obese children become obese adults? A review of the literature. Prev. Med. 1993;22:167-177.
31. Bridger T. Childhood obesity and cardiovascular disease. Paediatr Child Heart. 2009;14(3):177-182.
32. WHO. Obesity: Preventing and managing the global epidemic. Report on WHO consultation on obesity; 2000.
33. Hossain PK, El Nahas M. Obesity and diabetes in the developing world-a growing challenge. 2007;356(3):213-215.

34. Aneja A, El-Atat F, McFarlene SI, Sowers JR. hypertension and obesity. Recent Prog Horm Res. 2004;59:169-205.
35. Narkiewicz K. Diagnosis and management of hypertension in obesity. Obesity Reviews. 2006;7(2):155-162.
36. Chang LR. Patients' perspectives in following hypertensive guidelines on sodium intake and lifestyle modifications in Panama. University of South Florida. Graduate Thesis and Dissertation; 2013.
37. Hamer M, Steptoe A. Cortisol responses to mental stress and incident hypertension in healthy men and women. Journal of Clinical Endocrinology and Metabolism. 2012;97(1):29-34.
38. Wang HX, Leineweber C, Kirkeeide R, Svane B, Schenck-Gustafsson K, et al. Psychosocial stress and atherosclerosis: Family and work stress accelerate progression of coronary disease in women. The Stockhom female coronary angiography study. Journal of Internal Medicine. 2007;261:245-254.
39. Taylor KD, Adedoku A, Awobusuyi O, Adeniran P, Elochukwu O, et al. Explanatory models of hypertension among Nigerian patients at a University Teaching Hospital. Ethnicity & Health. 2012;17(6):615-629.
40. Heymann A, Liora V, Zucker I, Chodik G, Shalev V. Perceptions of hypertension treatment among patients with and without diabetes. BMC Family Practice. 2012; 13(24).
41. Kaplan M, Nunes A. The psychosocial determinants of hypertension. Nutr Metab Cardiovasc Dis. 2003;13:52–59.
42. Rozanski A, Blumenthal JA, Davidson KW, et al. The epidemiology, pathophysiology, and management of psychosocial risk factors in cardiac practice: The emerging field of behavioral cardiology. J Am Coll Cardiol. 2005;45:637–651.
43. Moseley JV, Linden W. Predicting blood pressure and heart rate change with cardiovascular reactivity and recovery: Results from 3-year and 10-year follow up. Psychosom Med. 2006;68:833–843.
44. McEwen BS. Protective and damaging effects of stress mediators: Central role of the brain. Dialogues Clin Neurosci. 2006; 8:367–381.
45. Meng L, Chen D, Yang Y, Zheng Y, Hui R. Depression increases the risk of hypertension incidence: A meta-analysis of prospective cohort studies. Journal of Hypertension. 2012;30(5):842–51.
46. Mesas AE, Leon-Muñoz LM, Rodriguez-Artalejo F, Lopez-Garcia E. The effect of coffee on blood pressure and cardiovascular disease in hypertensive individuals: A systematic review and meta-analysis. The American Journal of Clinical Nutrition. 2011;94(4):1113–26.
47. Vaidya A, Forman JP, Forman. Vitamin D and hypertension: Current evidence and future directions. Hypertension. 2010;56 (5):774–79.
48. Sorof J, Daniels Daniels S. Obesity hypertension in children: A problem of epidemic proportions. Hypertension. 2002; 40(4):441–447.

    DOI:10.1161/01.HYP.0000032940.33466.12

    PMID: 12364344

    (Retrieved 3 June 2009)
49. Lawlor DA, Smith GD. Early life determinants of adult blood pressure. Current Opinion in Nephrology and Hypertension. 2005;14(3):259–64.
50. Brien Eoin O, Beevers DG, Lip Gregory YH. ABC of hypertension. London: BMJ Books; 2007.

    ISBN: 1-4051-3061-X
51. Hua Y, Wang B, Wallen G, Shao P, Ni C. et al. Health promoting lifestyles and depression in urban elderly Chinese. PLOS ONE. 2015;10(3):e0117998.
52. Cakir H, Pinar R. Randomized controlled trial on lifestyle modification in hypertensive patients. West J Nurs Res 2006;28(2):190-209.
53. Weir MR. Hypertension. [E-book]. USA: Versa Press; 2005.

    (Ref. 27 February 2015)
54. Bunker J. Hypertension: Diagnosis assessment and management. Nursing Standard. 2014;28:42.
55. Petkeviciene J, Klumbiene J, Simonyte S, Ceponiene I, Jureniene K. Physical, behavioral and genetic predictors of adult hypertension: The findings of the Kaunas cardiovascular risk cohort study. Plos One. 2014;9:10.
56. Cook NR, Cohen J, Hebert PR, et al. Implications of small reductions in diastolic blood pressure for primary

prevention. Arch Intern Med. 1995;155(7): 701–709.

57. Williams B, Poulter NR, Brown MJ, et al. Guidelines for management of hypertension: Report of the fourth working party of the British Hypertension Society, 2004-BHS IV. J Hum Hypertens. 2004; 18(3):139–185.
58. Opie RS, Segal L, Jacka FN, Nicholls L, Dash S, et al. Assessing healthy diet affordability in a cohort with major depressive disorders. J. Public Health Epidemiol. 2015;7(5):159-169.
59. Elmer J, Obarzanek E, Vollmer W, Simons-Morton D, Stenes V, et al. Effects of comprehensive lifestyle modification on diet, weight, physical fitness and blood pressure control. Annals of Internal Medicine. 2006;144(7):485.
60. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, et al. 2013 ESH/ESC guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC). J Hypertens. 2013;31:1281–1357.
61. Mungal-Singal V. Lifestyle changes for hypertension. South Africa Family Practice 2012;54(2):S12- S16.
62. McDonald A, Motta J, Roa R, Fontes F, Bastista I, et al. Prevalencia de factores de riesgo asociados a enfermedad cardiovascular (PREFEC) [Prevalence of risk factors associated to cardiovascular disease]. Panama: Instituto Conmemorativo Gorgas de Estudios de la Salud; 2010. Brasil.
63. European Society of Hypertension/ European Society of Cardiology (ESH/ESC). Guidelines for the management of arterial hypertension. European Heart Journal. 2013;2185-2186.
64. National Heart Foundation of Australia. Guideline management of hypertension assessing and managing raised blood pressure in adults; 2010.
    (Accessed online on 24th March, 2017) Available:www.heartfoundation.org.au
65. He FJ, Li J, MacGregor GA. Effect of the longer term modest salt reduction on blood pressure. Cochrane Database Syst Rev. 2013;30(4):CD00493.
66. Daly RM, Ahlborg HG, Ringsberg K, Gardsell P, Sembo L, Karlsson MK. association between diagnosis in habitual physical activity and changes in bone density, muscle strength and functional performance in elderly men and women. Journal of American Geriatrics Society. 2008;56(12):2252-2260.
67. Kolasa KM. Dietary approaches to Stop Hypertension in clinical practice: Primary care experience. Clinical Cardiology. 2009; 22(S3):16-22.
68. National Heart, Lung and Blood Institute (NIH). Studies show lifestyle changes benefit blood pressure: Sodium reduction/ weight loss cut need for drugs in elderly. November 13; 1996.
69. Whitworth JA. World Health Organization, International Society of Hypertension Writing Group. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens. 2003;21(11):1983–1992.
70. Chen ST, Maruthur NM, Appel LJ. The effect of dietary patterns on estimated coronary heart disease risk: Results from the Dietary Approaches to Stop Hypertension (DASH) trial. Circ Cardiovasc Qual Outcomes. 2010;3(5):484–489.
71. Craddick SR, Elmer PJ, Obarzanek E, et al. The DASH diet and blood pressure. Curr Atheroscler Rep. 2003;5(6):484–491.
72. Appel LJ, Champagne CM, Harsha DW, et al. Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA. 2003;289(16):2083–2093.
73. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure [JNC 7]. Physician effectiveness in interventions to improve cardiovascular medication adherence: A systematic review. Journal of General Internal Medicine. 2004;25:1090-1096.
74. Brill J. Lifestyle intervention strategies for the prevention and treatment of hypertension. American journal of lifestyle medicine 2011;5(4):346-360.
75. Thomas MC, Atkins RC. Blood pressure lowering for the prevention and treatment of diabetic kidney disease. Drugs. 2006; 66(17):2213-2234.
76. Stranges S, Wu T, Dorn JM. Relationship of alcohol pattern to risk of hypertension: A

population based study. Hypertension. 2004;44:813-819.

77. Dickinson HO, Mason DJ, Nicolson DJ, Campbell F, Beyer FR, et al. Lifestyle interventions to reduce raised blood pressure: A systematic review of randomized controlled trials. Journal of Hypertension. 2006;24(2):215-233.
78. Stead LF, Perera R, Bullen C, Mant D, Lancaster T. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev. 2008;23(1):CD000146.
79. Dubbert PM, Robinson JC, Sung JH, Ainsworth BE, Wyatt, et al. Physical activity and obesity in African Americans. The Jackson Heart Study: Ethnicity and Disease. 2010;20:383-389.
80. WHO. Global recommendations on physical activity for health; 2017.
(Accessed online on 20th February 2017) Available:www.who.int/dietphysicalactivity/factsheets_recommendatios/en/
81. American Heart Association 2014. About high blood pressure.
(Accessed online on 10th April, 2015) Available:http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/AboutHighBloodPressure/About-High-Blood-Pressure_UCM_002050_Article.jsp
82. Lee DC, Sui X, Church TS, Lavie CJ, Jackson AS, Blair SN. Changes in fitness and fatness on the development of cardiovascular disease risk factors hypertension, metabolic syndrome, and hypercholesterolemia. J Am Coll Cardiol. 2012;59:665–72.
83. U.S. Department of Health and Human Services. 2008 Physical activity guidelines for Americans: Be active, healthy, and happy! 2008
(Accessed 10 June 2013)
Available:http://www.health.gov/paguidelines/
84. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's physical activity guidelines for adults. Int J Behav Nutr Phys Act. 2010;7:39.
85. Pavey TG, Peeters G, Bauman AE, Brown WJ. Does vigorous physical activity provide additional benefits beyond those of moderate? Med Sci Sports Exerc; 2013 DOI: 10.1249/MSS.0b013e3182940b91
86. Williams PT, Thompson PD. Walking versus running for hypertension, cholesterol, and diabetes mellitus risk reduction. Arterioscler Thromb Vasc Biol. 2013;33:1085–91.
87. Haskell WL, Lee I, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc. 2007;39(8):1423–1434.
88. Cornelissen VA, Smart NA. Exercise training for blood pressure: A systematic review and meta-analysis. J Am Heart Assoc. 2013;2:e004473.
89. Cornelissen VA, Buys R, Smart NA. Endurance exercise beneficially affects ambulatory blood pressure: A systematic review and meta-analysis. J Hypertens. 2013;31:639–48.
90. Huang G, Shi X, Gibson CA, Huang SC, Coudret NA, Ehlman MC. Controlled aerobic exercise training reduces resting blood pressure in sedentary older adults. Blood Press; 2013.
DOI: 10.3109/08037051.2013.778003
91. Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, et al. Using pedometers to increase physical activity and improve health: A systematic review. JAMA. 2007;298:2296–304.
92. Cornelissen VA, Fagard RH, Coeckelberghs E, Vanhees L. Impact of resistance training on blood pressure and other cardiovascular risk factors: A meta-analysis of randomized, controlled trials. Hypertension. 2011;58:950–8.
93. Linden W, Moseley JV. The efficacy of behavioral treatments for hypertension. Appl Psychophysiol Biofeedback. 2006;31: 51–63.
94. Chesney MA, Black GW, Swan GE, et al. Relaxation training for essential hypertension at the worksite: I. The untreated mild hypertensive. Psychosom Med. 1987;49:250–263.
95. Stetter F, Kupper S. Autogenic training: A meta-analysis of clinical outcome studies. Appl Psychophysiol Biofeedback. 2002;27:45–98.
96. Ospina MB, Bond TK, Karkhaneh M, et al. Meditation practices for health: State of

the research. Agency for Healthcare Research and Quality; Rockville, MD: 2007. (Evidence report / technology assessment no. 155).

97. Maharishi Mahesh Yogi: The science of being and art of living. New American Library; New York; 1963.
98. Roth R. Maharishi Mahesh Yogi's Transcendental Meditation. Primus; Washington, DC; 2002.
99. Eppley K, Abrams AI, Shear J. Differential effects of relaxation techniques on trait anxiety: A meta-analysis. J Clin Psychol. 1989;45:957–974.
100. Nakao M, Yano E, Nomura S, et al. Blood pressure-lowering effects of biofeedback treatment in hypertension: A meta-analysis of randomized controlled trials. Hypertens Res. 2003;26:37–46.
101. Eisenberg DM, Delbanco TL, Berkey CS, et al. Cognitive behavioral techniques for hypertension: Are they effective? Ann Intern Med. 1993;118:964–972.
102. Juan CC, Shen YW, Chien Y, Lin YJ, Chang SF, Ho LT. Insulin infusion induces endothelin-1-dependent hypertension in rats. Am J Physiol Endocrinol Metab. 2004; 287:E948–E954.
103. Duarte-Silva D, Figueiras A, Herdeiro MT, Teixeira Rodrigues A, Silva Branco F, Polónia J, et al. PERSYVE - Design and validation of a questionnaire about adverse effects of antihypertensive drugs. Pharm Pract (Granada). 2014;12(2):396.
104. Chin YR, Lee IS, Lee HY. Effects of hypertension, diabetes, and / or cardiovascular disease on health related quality of life in elderly Korean individuals: a population-based cross-sectional survey. Asian Nurs Res (Korean Soc Nurs Sci). 2014;8(4):267–73.
105. Zhu X, Wong FK, Wu LH. Development and evaluation of a nurse-led hypertension management model in a community: A pilot randomized controlled trial. Int J Clin Exp Med. 2014;7(11):4369–77.
106. Carvalho MA, Silva IB, Ramos SB, Coelho LF, Gonçalves ID, Figueiredo Neto JA. Qualidade de vida de pacientes hipertensos e comparação entre dois instrumentos de medida de QVRS. Arq Bras Cardiol. 2012;98(5):442–51. Brasil.
107. Sociedade Brasileira de Cardiologia; Sociedade Brasileira de Hipertensão; Sociedade Brasileira de Nefrologia. VI Diretrizes Brasileiras de Hipertensão. Arq Bras Cardiol. 2010;95(Supl 1):1–51.
108. Saleem F, Hassali MA, Shafie AA, Awad GA, Atif M, ul Haq N, et al. Does treatment adherence correlates with health related quality of life? Findings from a cross sectional study. BMC Public Health. 2012; 12:318.
109. Wal P, Wal A, Bhandari A, Pandey U, Rai AK. Pharmacist involvement in the patient care improves outcome in hypertension patients. J Res Pharm Pract. 2013;2(3): 123–9.
110. Cramer JA, Roy A, Burrell A, Fairchild CJ, Fuldeore MJ, et al. Medication compliance and persistence: Terminology and definitions. Value Health. 2008;11(1):44-47.
111. Osterberg L, Blaschke T. Adherence to medication. N Engl J. Med. 2005;353:487-497.
112. The Agency for Health Research and Quality 2003 (AHRQ) in the Office of the National Coordinator for Health Information Technology [ONC]. Issue Brief: Medication Adherence and Health IT; 2014. Available:http://www.healthit.gov/sites/default/files/medicationadherence_and_hit_issue_brief.pdf
113. Berger BA, Krueger KP, Felkey BG. The pharmacist's role in treatment adherence Part 1: Extent of the problem. US Pharm. 2005;11:50-4.
114. Moura Almeida A, Simone G, Cesarino, CB, Mendes Costa IA. Factors determining non-adherence to hypertension treatment. Enfermería Global. 2016;43:27-38.
115. Santos MVR, Oliveira DC, Arraes LB, Oliveira DAGC, Medeiros L, et al. Adesão ao tratamento anti-hipertensivo: Conceitos, aferição e estratégias inovadoras de abordagens. Revista da Sociedade Brasileira de Clínica Medica. 2013;11(1): 55- 61. Brasil.
116. Mahrous FM. Factors affecting compliance of hypertensive patients toward therapeutic Regimen. Life Science Journal. 2015; 12(10):62-69.
117. Coulon SM, Wilson AK, Griffin S, St. George SM, Alia KA, et al. Formative Process Evaluation for Implementing a Social Marketing Intervention to Increase Walking Among African Americans in the Positive Action for Today's Health Trial. American Journal of Public Health. 2012; 102:2315-2321.

118. DiMatteo MR, Haskard KB, Williams SL. Health beliefs, disease severity, and patient adherence: A meta-analysis. Med Care. 2007;45(6):521–528.
119. Tabor PA, Lopez DA. Comply with us: Improving medication adherence. J Pharm Pract. 2004;17(3):167-81.
120. Palota L. Adesão ao tratamento da hipertensão arterial: Estudo entre usuários cadastrados no Centro de Saúde de um município do interior paulista [dissertação]. Ribeirão Preto: Escola de Enfermagem de Ribeirão Preto/USP; 2010. Brasil.
121. American College of Preventive Medicine. Medication Adherence Time Tool: Improving Health Outcomes; 2011. (Accessed on 21st December, 2016) Available:http://www.acpm.org/?MedAdherTT_ClinRef
122. Giorgi DMA. Estratégias para melhorar a adesão ao tratamento anti-hipertensivo. Revista Brasileira de Hipertensão. 2006; 13(1):47-50. Brasil.
123. McCarley P. Patient empowerment and motivational interviewing: Engaging patients to self-manage their own care. Nephrology Nursing Journal. 2009;36(4): 4009-413.
124. Bellington E, Simpson J, Unwin J, Bray D, Giles D. Does hope predict adjustment to end stage renal failure and consequent dialysis? British Journal of Health Psychology. 2008;13:683-699.
125. Tsay SL, Hung LO. Empowerment of patients with end stage renal diseases. A randomized control trial. International Journal of Nursing Studies. 2004;41(1):59-65.
126. Mann JF. What's new in hypertension 2008? Nephrol Dial Transplant. 2009;24: 38-42.
127. Foster JM, Smith L, Bosnic-Anticevich SZ, Usherwood T, Sawyer SM, et al. Identifying patient specific beliefs and behaviors for conversations about adherence in asthma. Intern Med J. 2012; 42(6):e136-144.
128. Stafford L, Jackson HJ, Beck M. Illness beliefs about heart disease and adherence to secondary prevention regimens. Psychosom Med. 2008;70(8): 942-948.
129. Gellard WF, Grenard JL, Marcum ZA. A systematic review of barriers to medication adherence in the elderly: Looking beyond cost and regimen complexity. Am J Geriatr Pharmacother. 2011;9(1):11-23.
130. Starks H, Simoni J, Zhao H, Huang B, Fredriksen-Goldse K. et al. Conceptualizing antiretroviral adherence in Beijing, China. Psychological and socio-medical aspect of HIV/AIDS. 2008; 20:6.
131. Karamanidou C, Clatworthy J, Weinman J, Horne R. A systematic review of the prevalence and determinants of non-adherence to phosphate binding medication in patients with endstage renal disease. BMC Nephrol. 2008;9:2-8.
132. Molloy GJ, Perkins-Porras L, Bhattacharyya MR, Strike PC, Steptoe A. Practical support predicts medication adherence and attendance at cardiac rehabilitation following acute coronary syndrome. J Psychosom Res. 2008;65(6): 581-586.
133. Sherbourne CD, Hays RD, Ordway L, Dimatteo MR, Kravitz RL. Antecedants of adherence to medical recommendations: Results from the medical outcomes study. Journal of Behavioral Medicine. 1992; 15(5):447-468.
134. DiMatteo MR. Variations in patients' adherence to medical recommendations: A quantitative review of 50 years of research. Med Care. 2004;42(3):200–209.
135. Miller WR, Zweben A, Diclemente CC, Rychtarik RG. Motivational enhancement therapy manual. A clinical research guide for therapists treating individuals with alcohol abuse and dependence. Project MATCH Monograph Series, Rockville; 1992.
136. Stephens MA, Fekete EM, Franks MM, Rook KS, Druley JA, et al. Spouses' use of pressure and persuasion to promote osteoarthritis patients' medical adherence after orthopedic surgery. Health Psychol. 2009;28:48-55.
137. Knight KM, Mcgowam L, Dicksens C, Bundy C. A systematic review of motivational interviewing in physical health care settings. British Journal of health Psychology. 2006;11:319-332.
138. Sevick MA, Trauth JM, Ling BS, Anderson RT, Piat GA. Patients with complex chronic disease: Perspective on supporting self-management. Journal of General Internal Medicine. 2007;22(3):438-444.

139. Levenskey ER, Forcehimes A, O`Donohue WT, Beitz K. Motivational interviewing: An Evidenced based approach to counseling help patients follow treatment recommendations. American Journal of Nursing. 2007;107(10):50-58.
140. Gee ME, Bienek A, Campbell NR. Prevalence of, and barriers to, preventive lifestyle behaviors in hypertension (from a national survey of Canadians with hypertension). The American Journal of Cardiology. 2012;109(4):570–575.
141. Jolles EI, Padwal RJ, Clark AM, Braam B. A qualitative study of patient perspectives about hypertension. ISRN Hypertension; 2014. (ID 671691), 10 pages.
142. Sheena P, Arumugam I, Sabhashini N. Compliance regarding lifestyle modifications in preventing complications among hypertensive patients in tertiary care hospital. International Journal of Advanced Research. 2016;4(6):1644-1648.
143. Nyaradzai AK, Maradzika J. Correlated compliance with lifestyle modifications in preventing complications among hypertensive patients. International Journal of Health Promotion and Education. 2015; 53(6):315-327.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/19561