

NUTRITIONAL MANAGEMENT OF HYPERTENSION USING FOOD SOURCES THAT INCREASES NITRIC OXIDE

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Abstract

The study covers nutritional management of hypertension using food sources that increases nitric oxide. Food and nutrition education is study of food and what to eat to improve and build strong immune system that withstand diseases. Nutritional education helps in building a nation capable of using food sources from our environment to reduces or remedy some diet related non communicable diseases such as hypertension. To achieve this, the study covers the concept of nitric oxide and its functions to the body, hypertension as a challenging non communicable disease, causes, complication and treatment. The study also mentions some food sources that can boost nitric oxide in the body and how it can help to lower or normalize hypertension. Conclusion, recommendations for further study

Keyword: Nutritional management, Hypertension, Food, sources, Nitric oxide

Introduction

Nitric Oxide

The colorless gas with the formula NO is Nitric oxide also known as nitrogen monoxide, it is a free radical, unpaired electron and heteronuclear, which is having different type. Nitric oxide is a compound formed in the human body and end conversion process turns it into a useful chemical. Nitric oxide can be seen as a supplement; it can be gotten from eating of normal diet. Research suggests that getting nitrates from vegetables is a particularly effective method of improving your heart health. Nitric oxide occurs naturally in the environment during lightning. It is formed from molecular nitrogen and oxygen at very high temperatures of $>10000^{\circ}\text{C}$, it is produced by reducing nitric acid in the laboratory, it has melting point of -163.6°C and a boiling point of -151.7°C . The total sum of nitrate (NO_3^-) and nitrite (NO_2) content in the plasma is measured by Nitric oxide. Nitrate oxides seen as a toxic air pollutant. It is a structurally simple, low-molecular-weight, highly lipophilic free radical. It is extremely reactive, readily forming other nitrogen oxides, which curtails NO bioavailability temporally and spatially: NO has a very short half-life; NO can travel only limited distances before being oxidized. Humans produce nitric oxide by several mechanisms. From the amino acid L-arginine by the enzyme nitric oxide synthase (NOS) and inorganic nitrates in green leafy vegetables, fruits, cereals, and meat. Nitric oxide controls cutaneous microcirculation, it has many health benefits, which include lowering of blood pressure, improve blood flow and boost exercise performance, (Van De Walle 2023). This author further stated that nitric oxide is produced in the body naturally as a molecule, the vital role is to relax the inner molecule of the blood vessel, making it widen and improve circulation. The production of nitric oxide is vital because the blood nutrient and oxygen to travel to different parts of the body effective, every individual have different ways to sustain minimum level of nitric oxide in the body. Nitric oxide is a naturally produced vasodilator, which help expand and enlarging all sides of the blood vessel that controls and regulates vascular tone and therefore controls and regulates blood pressure, Bryan (2022). Nitric oxide is a molecule that's produced naturally by the body, and it's important for many aspects of your health. Its most important function is vasodilation, meaning it relaxes the inner muscles of the blood vessels, causing them to widen and increase circulation. Nitric oxide production is

essential for overall health because it allows blood, nutrients, and oxygen to travel to every part of your body effectively and efficiently.

Functions nitric oxide to the body

- Regulates the chemical agents that causes dilation of the blood vessel by reducing blood pressure.
- Mediates by affecting the exterior skin reducing oedema and inflammation
- It helps skin pigmentation through ultraviolet induced melanogenesis, which is any group of naturally occurring dark pigments found in the human skin and hair.
- Promotes wound healing by cellular of rapid spread of formation and development of new blood vessel
- It is a commercial product to all types of living organisms, including bacteria, plants, fungi, and animal cells
- It is a key vertebrate biological messenger, playing a role in a variety of biological processes.
- Inner lining of blood vessel uses nitric oxide to signal the surrounding smooth muscles to relax, resulting increasing blood flow
- It helps in penile erection during sexual intercourse
- Increases blood flow to the kidney due its vasodilatory effect.
- Increases the filtration rate and the production of urine.

Hypertension

Hypertension is defined as sustained systolic pressure exceeding 139mm Hg or diastolic blood pressure exceeding 89mm Hg. Hypertension remains number one modifiable risk factor in the onset and progression of cardiovascular disease, Bryan (2022). Hypertension is also known as high blood; it is force of blood pushing against the wall of the pancreas as its flow through the arteries on the blood vessel that carry blood from the heart to other parts of the body while vein returns blood from other parts of the body to the heart. Blood pressure is expressed in two numbers, the higher number is systolic blood pressure which is the pressure in the arteries when the heart muscle is contracting, which is drawing itself together into a smaller unit and pumping blood into the arteries. The systolic blood pressure is 120 millimeter of mercury and diastolic is the second value when heart is relaxed is 80mm Hg, elevator in any of them either systolic or diastolic blood pressure are strong indicator of disease. Hypertension is describing as silent disorder because it does not cause symptoms. A blood pressure reading of 139/89 is regarded as pre-hypertension while a blood pressure reading of 140/90 and above is considered as high blood pressure and systolic blood pressure reading 90-100 is consider as low blood pressure. Gordon & Smith, (2009), describe hypertension (high blood pressure) is when the pressure in the blood vessels is too high (140/90 mmHg or higher). It is a common uncommunicable disease a but can be serious if not treated, on symptom is felt by the person been affected and can be known by blood pressure checked. Estimated 1.28 billion adults aged 30–79 years worldwide have hypertension, most (two-thirds) living in low- and middle-income countries estimated 46% of adults with hypertension are unaware that they have the condition and also high blood pressure causes about 70% of stroke, heart attack and heart failure and causes about 13.5% of death worldwide. Diet and lifestyle are critically important to controlling and combatting hypertension:

- Less than half of adults (42%) with hypertension are diagnosed and treated.
- Approximately 1 in 5 adults (21%) with hypertension have it under control.
- Hypertension is a major cause of premature death worldwide.
- One of the global targets for no communicable diseases is to reduce the prevalence of hypertension by 33% between 2010 and 2030.

Why Control Blood Pressure

The need to controlled is prevent cardiovascular disease, kidney disease, stroke and related decline in brain function, poor blood circulation in the legs, problem with vision and sudden death, all these can found with the individual that has high blood pressure, cerebrovascular disease, this is a disease of the blood vessels supplying the brain; peripheral arterial disease, is a disease of blood vessels supplying the arms and legs; The individual with high blood pressure need treatment.

Causes of Hypertension

A family history of hypertension is a risk factor and also blood pressure usually increase as person aged, some increase is caused by atherosclerosis, as plaque buildup in the arteries and it became less flexible and cannot expand. when vessel remain rigid, blood pressure remains high. The plaque begins to decrease the blood supply to the kidneys, decreasing their ability to control blood volume and in turn blood pressure. The systolic and diastolic pressures fall into different categories, Gordon & Smith, (2009).

- Normal blood pressures range 120/80
- Per-hypertension 120/80-140/90
- Hypertension 140/90 and above

Overweight people and elderly adults have greater risk of having hypertension than individual that slim, obesity is leading lifestyles factor related to hypertension. Blood vessels develop to support excess tissue in overweight and obese individual, this causes the blood vessel increase work by the heart and blood pressure. Hypertension connected to obesity if raised blood insulin (hormone that regulates carbohydrate metabolism) level result in insulin resistant. it is when the cell muscles fat and liver are not responding well to insulin and cannot use glucose from blood. The increase insulin level increase sodium retention in the body and increase atherosclerosis (buildup of fat and cholesterol in wall of the artery causing obstruction of flow, the plaque may rupture, causing problem closure of the artery by clot). Weight loss can help treat hypertension. Inactive life style is another factor that is related to hypertension, if an obese person can engage in regular exercise and loss weight, that can help to treat hypertension. Also excess alcohol consumption is also responsible for about 10% increase of hypertension especially in middle aged men in Africa, life style can help lower high blood pressure such eating healthy food, avoiding tobacco and active life styles.

Symptoms of hypertension

People with very high blood pressure (usually 180/120 or higher) can experience symptoms including:

- severe headaches
- chest pain
- difficulty breathing
- nausea
- vomiting
- blurred vision or other vision changes
- dizziness
- nosebleeds
- abnormal heart rhythm
- neck/ shoulder pain

Food Sources that Boost Nitric Oxide

Vegetables

Vegetables are plants cultivated for some edible parts of it like leaves, roots, fruit or flower. These are high in nitrate, examples include celery, cress, lettuce, cabbage, carrot, spinach, leafy vegetables and likes, when eaten the nitrate are converted to nitric oxide, many health benefit to the heart. Nitrates is one of nitrogen form, useful for plant growth, they occur natural or non-natural origin. Nitrate are vasodilator medications, they help to widen the blood vessels, allowing more blood passage to the heart. Vegetable are antioxidants, the molecules that neutralize free radicals, which contribute the short live of nitric oxide, which are found in food like vegetables are called antioxidants and antioxidants are vitamin C, vitamin E, polyphenol and glutathione. Vegetable increase and maintain optimal level of nitric oxide and also high in nitrate

Tee-molegrito (2021) define green leafy vegetables are edible plant leave, examples spinach, cabbage, lettuce and likes contains vitamins, iron, magnesium, phosphorus, folic acid and calcium. They are calories dense and less carbohydrate, protein and fat. They help to eliminate free radicals. Vegetables help to lower blood pressure by flushing sodium out in the body through pee and relaxes the blood vessel is called DASH diet (dietary approach to stop blood pressure), this is eating pattern for both preventing and treating of blood pressure. It also may help lower cholesterol linked to heart disease, called low density lipoprotein (LDL) cholesterol. The diet limits foods that are high in salt, sugar and saturated fat, such as in fatty meats and full-fat dairy products and include fat-free products, vegetables, fish, poultry, beans and nuts.

The main aim of the DASH diet is not to lose weight but to reduce blood pressure. However, it can also help those who want to lose weight, lower cholesterol and manage or prevent diabetes. DASH encourages a person to eat less sodium (the key ingredient in salt) and increase their intake of magnesium, calcium and potassium. DASH is not a vegetarian diet, but it adds more fruits and vegetables, low or nonfat dairy foods, beans, nuts, and other nutritious items. These strategies help lower blood pressure. It provides suggestions about healthful alternatives to “junk food” and encourages people to avoid processed foods

According to 2019 research published in nutrients, three specific minerals that can have a positive impact on blood pressure are potassium, calcium and magnesium. Dark leafy greens are a good source of all three of these nutrients. Potassium plays a large role in blood pressure management, as it helps the body eliminate excess sodium through urine, which can reduce water retention and blood volume and lead to lower blood pressure. Calcium can influence blood pressure through its actions on the smooth muscle cells that line artery walls. Magnesium helps manage blood pressure by increasing nitric oxide levels, which helps blood vessels relax. A 2020 review in Hypertension noted that populations who consumed a higher-potassium, lower-sodium diet had lower rates of hypertension.

Dark leafy greens like cabbage, chard, spinach, kale and arugula are high in nitrate, a compound naturally found in soil, water and food. Bacteria and enzymes in the body convert the nitrate in plant-based food like leafy greens into nitrous oxide which acts like a messenger, telling blood vessels to relax and dilate and thereby lowering blood pressure. Most manufacturers also add nitrate to processed meats as a preservative, but it acts very differently in the body than plant-based nitrate.

In a 2021 Danish cohort study published in the European Journal of Epidemiology, participants who consumed at least 1 cup of green leafy vegetables daily had a lower systolic blood pressure at baseline and a significantly reduced risk of cardiovascular disease events like heart failure and stroke, compared to those who ate less green leafy vegetables.

The relationship between vitamin C and blood pressure, the risk of developing high blood pressure is oxidative damage to blood vessels. Oxidation is a normal and necessary process, it is harmful if there is an imbalance between unstable compounds called free radicals

and antioxidants like vitamin C, free radicals will begin to cause damage to tissues like the blood vessels if no enough antioxidants, so eating more antioxidant-rich foods can help keep free radicals in check. Vitamin C helps this process along by increasing the activity of the enzyme that converts the nitrate in food into nitrous oxide. Which act as chemical messenger that tells blood vessels to relax, when it breaks down nitrate from food. Dark green leafy vegetables are high in fat-soluble pigments called carotenoids that have been associated with many protective health benefits. Like vitamin C, carotenoids also act as an antioxidant, helping to reduce oxidative stress that can contribute to an increased risk of high blood pressure.

Garlic

Garlic belong to the family of onion, it has low calories, boosts immune system, lower blood pressure, lower cholesterol, each segment is called a clove and throughout history garlic has been known for its medicinal properties, garlic contain allicin, vitamin C, B6 and manganese. Hypertension is one of the factor that lead to cardiovascular diseases like heart attack and stroke, garlic contain antioxidant that can help protect against cognitive decline related to cell damage and ageing, (Kristeen 2022)

Allicin, the main active compound in garlic, is thought to be largely responsible for garlic's blood-pressure-lowering properties, angiotensin II production are most time prevented by allicin, a compound responsible for increasing blood pressure by causing blood vessels to tighten up or contract making nitric oxide available. When angiotensin production is prevented, the allicin make it easy for blood to flow freely, preventing blood pressure and keep within healthy range. Garlic is herb that reduce and prevent blood pressure because it is anti-inflammatory and antioxidant properties. Allicin also appears to increase the production or availability of hydrogen sulfide and nitric oxide, two compounds crucial for regulating blood pressure levels, it also help ease inflammation and reduces free radicals, u tissue in unstable molecules that affects cells and tissues in human body, amino acid found fresh garlic is alliin A recent review study demonstrated that vitamin B12 levels may influence garlic's effectiveness at lowering blood pressure. The red blood cells respond to the sulfur in garlic, creating nitric oxide (NO) and hydrogen sulfide (H₂S) gasses. These compounds relax and expand our blood vessels. The aromatic contains allicin, for example cardio protective sulfur-containing compound released when eating raw garlic is eaten is responsible for garlic signature aroma and flavor. The effect of this compound on cholesterol and blood pressure reduction are beneficial to the cardiovascular system, also garlic help to fend off free radical, reduce oxidative stress and combat inflammation, it is high in antioxidant like polyphenol and flavonoid, these antioxidants rich food can fight free radical damage which decrease and reduce the risk of the diseases, Kristeen (2022) Garlic can enhance the bioavailability of nitric oxide and may increase levels of nitric oxide synthase, the enzyme that converts L-arginine to nitric oxide. Hypertension is one of the leading death, addressing it is important using garlic as individual suffering from it will help lower high blood pressure.

Nuts and Seed

Nuts are different fruits having shell enclosed kernel, they are hard fruit that not split open at maturity, examples are walnut, cashew nut, peanut, tiger nut while seeds are plants that contains an embryo, endosperm and seed coat and also contained in the fruits, examples are flax seed, pumpkin seed sesame seed. Nuts and seeds are high in arginine, a type of amino acid that is involved in the production of nitric oxide, this compound is important in improving blood flow and prevent blood clots and increases nitric oxide and reduces the risk of heart diseases and stroke. The consumption of nut and seed improve blood flow and blood fluidity. Nuts contain antioxidants such as selenium, vitamin E, and polyphenols, "These help protect the heart and blood vessels from oxidative damage. Magnesium is an important mineral that helps to regulate blood pressure and prevent heart disease."

According to an article published in February 2020 in the journal *Nutrients*, research suggests that eating a daily serving of walnuts can improve cognitive function and also reduce the risk of cardiovascular disease, depression, and type 2 diabetes, which are risk factors for the development of dementia. The article also notes that walnuts have antioxidant and anti-inflammatory effects on the body, Bende (2021). Eating walnuts daily lowering central blood pressure. Central blood pressure is a measure of the pressure exerted on internal organs like the heart and is considered an important risk factor for cardiovascular disease. Walnut contains plant base omega 3 fatty, which is alpha linoleic acid (ALA) which have positive effect on blood pressure. Gordon and Smith (2009) state that alpha-linoleic acid is essential omega 3 fatty acid with 18 carbons and three double bonds. Flax seed and walnut are rich vegetable sources of omega 3 fatty acid, alpha-linoleic acid are rich sources of plant sterol known to inhibit intestinal absorption of cholesterol, it is called essential fatty acid because it must consume in the diet because of its vital role in the body. Alpha-linoleic is known to reduce the risk of high blood pressure by 30%, It is essential because it is needed for normal human growth and development. Guohua, Xinpei and Jia (2020) reported to be associated with lowering hypertension, the plant derived omega3 polyunsaturated fatty acid alpha-linoleic acid (ALA) is abundant in nut, seed, soybeans, rapeseed and flaxseed oil. ALA is promising alternative reduction of cardiovascular diseases because it reduces the hardness of the arteries (atherosclerosis), the diet high in ALA seems to reduce the plaque that block the passage of blood in the blood vessel, thereby reducing the pressure of blood flow. Plaque is fatty build-up that is characterized by atherosclerosis. ALA help regulate the blood pressure and make the blood relax

Walnuts contain a range of bioactive phenolic compounds in addition to fiber that could play a part in lowering blood pressure so this study again points to the benefits of eating whole foods rather than focusing on individual nutrients. Frequent consumption of nuts is associated with a lower risk of incident hypertension in US male physicians

Citrus

Studies have shown that nutrients called flavonoids present in citrus fruits like oranges, lemons, and grapefruit, play a role in lowering blood pressure. Flavonoids are a form of plant chemicals that function as antioxidants in the body, protecting against free radicals' damaging effects. Antioxidants are compound that stop the oxidation, the chemical reaction that can produce free radical. Commercial orange juice has a significant effect on blood pressure. As concentrated products have greater contents of flavonoids, pectin, and essential oils compared to natural juice, they are more effective on blood pressure. Millad (2023) stress that Citrus contain vitamins A, C, and E, it contains fructose, which is sugar found in fruits, fiber delay sugar absorption during digestion process, fructose is absorbed too, affecting blood sugar level. The rise of blood glucose will to insulin spike, if it continues could lead to insulin resistance, can lead to high blood sugar and high cholesterol.

Carotene are vitamins and minerals found in orange, yellow and red, it is the pigments found largely in fruit, vegetables and dark green leafy vegetables. They are components of the pigment systems and are involved in the primary light absorption. Two major types of carotene are: Alpha and beta: found in carrots. Alpha-carotene is the abundant carotenoid in the food and also can be converted vitamin A While Beta-carotene is the more common form of the two. Lycopene is the red pigment found in red fruit and tomatoes α -carotene is one of the most abundant carotenoids in the diet and can be converted to vitamin A, but with only one-half the activity as β -carotene (contains only one β sf you need to lower your blood pressure, start your day with some orange juice. Studies have shown that nutrients called flavonoids present in citrus fruits like oranges, lemons, and grapefruit, play a role in lowering blood pressure. Flavonoids are a form of plant chemicals that function as antioxidants in the body, protecting against free radicals' damaging effects. Studies reported drinking two glasses of orange juice a day lowered blood pressure in people with hypertension. It's important to note

that grapefruit has the potential to interfere with different types of medication, so always check with your doctor before eating grapefruit if you take medicine for high blood pressure or any other condition.

Conclusion

Nitric oxide is a naturally produced vasodilator, which help expand and enlarging all sides of the blood vessel that controls and regulates vascular tone and therefore controls and regulates blood pressure while hypertension is also known as high blood; it is force of blood pushing against the wall of the pancreas as its flow through the arteries on the blood vessel that carry blood from the heart, family history, over weight and elderly are risk factor to hypertension. Vegetables, garlic seed and nuts and likes, help the production nitric oxide in the body thus making the blood vessel widen for easy flow of blood thereby reduce the pressure and force of blood against the wall of vessel. Vegetables and likes, when eaten the nitrate are converted to nitric oxide, many health benefit to the heart. Having seen positive side of eating these foods regularly, it can be concluded that food is medicine.

Recommendations

The need for nitric oxide cannot be overestimated, having seen its functions to human, it is therefore recommended that adults whose blood pressure is above 140/ 90 should:-

- Eat vegetables regularly
- Reduce obesity and over weight
- Use DASH diet
- Make use of garlic regularly
- Eat nut and seed
- Include a small amount unsaturated fat.

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