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## **Influence of vegetarian diet on human body**

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## Abstract

All over the world there are more vegetarians than in previous years due to many reasons. One of them is positive influence on health what is shown in the latest research. The aim of the article is to review the influence of vegetarian diet on frequent diseases such as: hypertension, obesity, osteoporosis.

An analysis of scientific papers from Pubmed and Google Scholar was performed, which most accurately described the issue of impact vegetarian diet on human health. The following keywords have been used in the search: Vegetarian, hypertension, obesity, osteoporosis: vegetarian, hypertension, obesity, osteoporosis.

The researchers shown than vegetarians have lower systolic blood pressure and diastolic blood pressure by 10 and 5 mm Hg, they also lower overall mortality by 10-15%, risk of heart failure and by ~40%, stroke by~35% and coronary events by 20%.

Vegetarians also have statistically lower body mass index. What's more in this diet is more energy efficient thanks too low food energy density and helps keeping leptin on adequate level.

Research has shown than vegetarians have lower mineral bone density than non-vegetarian, although some studies has shown that risk of fractures in vegetarians and non-vegetarians was not affected by diet alternation.

Based on the results of the studies above vegetarian diet contributes to lower blood pressure and preventing from cardiovascular diseases. It helps to avoid obesity and to get rid of weights also doesn't have negative impact on osteoporosis.

**Key words:** Vegetarian, hypertension, obesity, osteoporosis

## 1. Introduction and purpose

Vegetarian diet is increasingly popular diet, approximately 375 million of people vegetarian what is estimated as 8 per cent of world's population [1]. This diet mainly consists of plant-based food but also includes animal-derived food such as: honey, eggs, milk, and dairy products. It also characterized by abstention from consuming meat including fishes and seafood [2]. The popularity of plant-based diet has increased over the years from 1% in 2000 up to about 4% nowadays just in Poland. Transition to plant-based diet is caused by various factor such as economic, religious, cultural, ethical and ecological. Although increasingly more people choose this type of diet due to its beneficial impact on human health. Despite many health benefits that vegetarian diet has shown in many studies vegetarian diet could have also negative consequences, that's why it needs to be balanced correctly to provide all necessary elements to protect body

from deficiencies [3]. Recently especially studies have been made to research hypertension, obesity and osteoporosis which are a few of civilization diseases.

The aim of this article was to review effects of vegetarian diet on these health disorders. The information used in this review were obtained from searching database of: Google Scholar and PubMed. The strategy of searching is based on the following keywords: vegetarian, hypertension, obesity, osteoporosis. Articles have been selected in terms of the thematic connection with this article and their content value.

## **2. Description of the state of knowledge**

### **2.1 Hypertension and vegetarian diet**

Hypertension, according to the European Society of Cardiology is defined as systolic blood pressure higher or equal to 140mmHg and/or diastolic blood pressure higher or equal to 90mmHg [4]. Hypertension is a major health problem around the globe. It affects about 25% of people globally [5, 6, 7]. Worldwide it is the leading cause of death and disability, reaching an approximated 18% of all deaths (9.4 million) [7,8]. Fifty-three percent of ischemic heart disease disability-adjusted life-years can be attributed to hypertension [8]. Moreover, hypertension is a risk factor of much life threatening diseases such as ischemic heart disease, ischemic and hemorrhagic stroke, atrial fibrillation or aortic aneurysm. Also, it is the most common comorbidity of chronic kidney disease, both as a cause and an effect of this disorder [9, 10].

Given the issues that emerge in relation to hypertension, it is necessary to treat it effectively. For most patients, that means medication-based treatment, aimed to lower blood pressure to an acceptable level. Numerous studies have shown a strong benefit from reducing blood pressure in hypertensive patients. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) lower by 10mmHg and 5mmHg respectively, brings down overall mortality by about 10 – 15%, risk of heart failure by ~ 40%, stroke by ~ 35%, and coronary events by ~ 20% [11, 12]. Interestingly, similar benefits arise from adjusting a patient diet. According to the World Hypertension League, approximately 50% of hypertension can be linked to patients unhealthy eating habits, out of those almost half (40%) is diet low in fruits and vegetables [7]. Following that trend, several studies have been conducted that investigate the effects of vegetarian diet on hypertension.

Vegetarian diet is not a very well-defined term, incorporating generally all plant-based diets, including: lacto-ovo-vegetarian diet (LOV), where mostly plant food is eaten, but dairy products and eggs are also included; pesco-vegetarian diet (PV), which allows the consumption of fish and other seafood; some combinations of the two and finally vegan diet (VG), composed solely of plants, excluding all animal products. People on vegetarian diets have statistically lower body mass index (BMI), obesity rate is generally lower among vegetarian communities [13,14,15,16]. Obesity is linked to a higher level of oxidative stress and reactive oxygen species [17,18], which are important factors in the pathophysiology of hypertension [19,20]. Another factor in the development of hypertension in obesity is insulin resistance, which often accompanies high BMI and is strongly linked to elevated blood pressure [21]. Vegetarian diet includes more dietary fiber, which is also connected to a lower blood pressure [24]. Furthermore, vegetarian diet improves blood viscosity and vasodilation, alters baroreceptors, regulates renin- angiotensin and the sympathetic nervous system, has anti-oxidant and anti-inflammatory properties, adjusts the gut microbiota [23,24]. All of these factors work together in reducing the risk of hypertension in vegetarians.

The effect of vegetarian diets on hypertension have been analyzed by several studies in various scenarios. Randomized controlled trials, where individuals were assigned either to a control group, eating a standard omnivorous western diet or on a vegetarian diet, have shown a significant decrease in blood pressure, both in normotensive and hypertensive subjects [25,26,27,28]. Similar trends are observed in observational studies, linking diets with low meat intake to a lower value of blood pressure [16,29,30]. These beneficial effects are observed across all subtypes of vegetarian diets, but are stronger in vegans than in LOV or PV. A conclusion can be drawn from mentioned results that changing dietary habits to vegetarian or plant-based can be beneficial for blood pressure and in turn can reduce the amount or dose of drugs taken by a hypertensive patient, which limits risk of adverse effects of these medications.

## **2.2 Plant-based diet vs. obesity**

The dynamically growing number of obese people over the years is a 21st century epidemic and a serious health problem in developed and developing countries [31]. According to data from 2016, the obesity problem affected approximately 11% of adult men and 15% of adult women globally [32]. Obesity is a significant risk factor for diseases such as all major gastrointestinal cancers, cardiovascular diseases and type 2 diabetes [33,34]. In the struggle against the extra kilogram, more and more people are taking a vegetarian diet. Interest in the plant-based diet and its potential positive health outcomes is constantly growing [35]. Some studies published so far even focus on the health-promoting effects of the plant-based diet on specific social groups such as the Blacks in the United States [36]. The availability of vegan or vegetarian products is increasing, making it easier to give up meat and animal products. Although the reasons why more and more people choose vegetarianism or veganism are different, one of them is the desire for effective weight loss.

In the fight against obesity it is important to keep your appetite at an appropriate level. A high fiber content in the plant-based diet could have a beneficial effect on gut hormonal-driven appetite regulation and regulation of digestion rate [35].

Additionally, plant-based diet has a beneficial effect on energy metabolism and leptin level in blood. Leptin is a peptide hormone that affects the regulation of appetite and has an important role in controlling body weight. The results of a study involving omnivores, lacto-ovo-vegetarians, and vegans showed that a plant-based diet reduces circulating leptin and body fat storage [37].

The results of the available studies are consistent - a well-balanced vegetarian diet is conducive to weight loss, and in some works it is even listed as one of the most effective methods in the fight against overweight and obesity [38,39,40]. The beneficial effect of a plant-based diet on increasing insulin sensitivity and improving blood plasma lipid profile is also emphasized [38]. This is an important advantage due to the clear correlation between obesity and insulin resistance [41]. The energy density is defined as the amount of energy per specific portion of food. An example unit is calories per gram. Both the water content and the distribution of macronutrients in a product affect its final energy density value [42]. The vegetarian diet is rich in low energy density products, so that a meal composed of plant-based products will be both saturated and less calorific than a standard meal of similar volume. This is a very beneficial solution for people who fight against obesity. In addition, the introduction of low calorie density products into the menu can be more beneficial for weight loss than reducing meal size [39]. It has been proven that a low-fat plant-based diet is conducive to weight loss, even when the supply of ingested calories is not controlled and participants eat to their preferred level of satiety. One of the advantages of The whole food plant-based diet (WFPB) is the fact that it is well balanced, rich in microelements and helps to maintain proper blood sugar levels [43].

## 2.3 Osteoporosis

Osteoporosis is a systematic disorder of progressive decrease in bone mass, altered structure and diminished bone durability due to the metabolic processes occurring in the bone. Main clinical symptoms of osteoporosis are low-energy fractures - fractures occurring with a presence of energy, that wouldn't break a healthy bone. Adequate nutrition, appropriate calcium and vitamin D intake, regular menstrual cycles and a well-balanced exercise program of exercise are essential elements in achieving peak bone mass, which is a necessity for prevention of osteoporosis and maintenance of healthy bones [44].

To fully analyze the effect of vegetarian diet on any alteration in osteoporosis occurrence, and/or deterioration of existing disease, there is a need of focusing on potentially modifiable osteoporosis risk factors. Within this investigation, only risk factors linked with altered nutrition are taken into the consideration.

Vegetarian diet is most commonly associated with insufficient intake of exogenous vitamins and nutrients like: calcium, vitamin D, vitamin B-12, protein, n-3( $\Omega$ -3)fatty acids [44]. All the stated above have a crucial role in maintaining proper bone function. Although zinc intakes are not necessarily lower quantitatively, they are considerably less bioavailable in vegetarian diets, which suggests the need for even higher intakes to maintain adequate status [44].

As the vegetarian diet involves restriction in the intake meat and fish-derived products, that are most commonly associated with high abundance of calcium and vitamin D, like anchovies and sardines (or any other fish eaten with bones especially that are rich in calcium) and vitamin D sources as salmon, cod liver oil, and other fish products [45], there could be an assumption driven that vegetarians lack the source of those nutrients. Such exclusion is directly linked to decreased levels of these crucial for bone health nutrients, whereas decreased levels of both calcium and vitamin D can be, with very high probability, linked to the development of osteoporosis [46]. What is important to state, the vast majority of supplementation of vitamin D is based on fish-derived products, which means that plant-based supplementation is not easily accessible and much more expensive than this excluded in terms of vegetarian diet. That clearly can be one of the reasons for increased potential risk of osteoporosis occurrence in vegetarians. A 2009 meta-analysis of 9 studies found that vegetarians had 4% lower Bone Mineral Density (BMD) than omnivores [44].

Despite this difference in BMD, some studies show that risk of fractures in vegetarians and non-vegetarians was not affected by diet alteration [46, 47]. This observation needs to be taken into consideration, as even significant changes in examination of BMD has no value without clinical symptoms like fractures. It cannot be diminished, as it can lead to possible clinical symptoms in the future, nevertheless low-energy fractures should be the main criteria taken into consideration in assessment of the influence of vegetarianism on severity of osteoporosis.

### 3. Summary and conclusions

The impact of vegetarian diet on preventing the hypertension and hypertension itself is significant. Using this diet people have lower blood pressure what prevents them from blood flow based diseases. What's more this well-balanced diet helps people to weight loss what could contribute in fight against obesity all over the world. There is correlation between the diet and osteoporosis, Bone Mineral density is generally lower by vegetarian although clinical symptoms hasn't shown that these bones are weaker.

Vegetarian diet has a great impact on human body that's why everyone should take it in consideration to change diet. Although there is a need for a further research of this diet and it is impact on other civilization diseases, like heart failure or metabolic syndrome as well as some mineral and vitamin deficiencies.

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