Reducing salt intake as a first step to prevent hypertension

INTRODUCTION

People consumed salt exclusively through food millions of years ago, which amounted to less than 0.5 g/day [1]. Salt became the most sought-after item in the world when it was discovered that it is a potent additive that extends the shelf life of foods and ensures microbiological safety [2]. Salt is a compound of sodium 40% and chlorine 60%, i.e. 1 g of salt contains 0.4 g of sodium (Na) and 0.6 g of chlorine (Cl). On the declaration worldwide, the manufacturer is obliged to declare the amount of salt per 100 g or 100 ml food [2].

Recent research indicates that the average daily consumption of salt is more than 10 g/day, although the use of refrigeration devices in households has reduced the real need for adding salt to food and extending the shelf life of food [3]. The physiology of the human body does not manage to find a way to excrete salt that is taken in excess with food, instead it opens the way to gradual but certain damage to certain organs, especially the cardiovascular system [4].

POSITIVE CORRELATION BETWEEN SALT INTAKE AND ARTERIAL BLOOD PRESSURE

Determining the amount of salt ingested by food has been a major challenge for researchers in the methodological sense of proving the amount of ingested salt. The INTERSALT study (International Study of Sodium, Potassium and Blood Pressure) involved a standardized method of determining sodium in diuresis and measuring blood pressure, performed in 32 countries on 10079 adults [5]. The INTERSALT study proved a di-
A direct connection between daily salt intake and blood pressure. This was later confirmed by the epidemiological studies INTERMAP (International Population Study on Macronutrients and BP) [6] and EPIC (European Prospective Investigation on Cancer and Nutrition) [7]. Namely, the data of the INTERMAP study confirm the correlation of sodium and sodium/potassium in the diet with blood pressure, despite the intake of other macronutrients. This conclusion about the sodium – blood pressure relationship adds to the abundance of data from other studies that imply that sodium intake influences the increase in blood pressure with age, which contributes to the high prevalence rate of prehypertension/hypertension and the high incidence rate of cardiovascular events [6]. The conclusion of the EPIC study, related to 24 h excretion of sodium, is that the risk of heart attack in an apparently healthy population is associated with high concentrations of sodium in diuresis, but with a decrease in natriuresis, blood pressure drops and thus the risk of heart attack [7].

Randomized studies based on the reduction of dietary salt intake also indicated a smaller or larger drop in blood pressure [8,9,10].

The daily population intake of salt in Great Britain in 2003 was 9.5 g, while in 2011 it was 8.1 g. Great Britain, through multisectoral action, led to a targeted reduction of the salt content in more than 85 industrially produced foods, which resulted in a 15% reduction in the population's salt intake over a period of eight years. From the point of view of public health, a small reduction in salt intake would contribute to a reduction in the incidence of hypertension and thus a reduction in the number of cardiovascular events [11].

The dose-dependent relationship between salt and blood pressure has been proven by many studies, the most famous of which is the DASH (Dietary Approach to Stop Hypertension) study [12]. The subjects were divided into three groups with the consumption of different amounts of salt per day (4/6/8 g salt/day) [12]. The conclusion of the DASH study was that during the research, subjects with the lowest salt intake had the lowest blood pressure [12].

The general conclusion of studies investigating the relationship between dietary salt intake and blood pressure led to recommendations on reducing salt intake and limiting total intake to 5 g of salt per day by the World Health Organization (WHO) [13] and the European Safety Agency of Food (EFSA) [14]. Great Britain has recommended a salt intake of 3 g per day as a long-term population target [15].

**PHYSIOLOGICAL MECHANISMS OF SALT ACTIONS IN THE ORGANISM**

In the body of an adult, with an approximate weight of 70 kg, sodium was found in the amount of 92 g, with different distributions in the body but the same amount regardless of gender and age [16]. Sodium has many roles in the body, the most important of which are:

- maintaining the excitability of muscle and nerve cells
- activation of enzyme systems
- maintenance of normal pH value in the digestive tract and serum
- regulation of water homeostasis in the body [17].

The amount of ingested sodium necessary to maintain sodium homeostasis in the body is 500 mg per day [18].

Increased salt intake causes suppression of the Renin-Angiotensin-Aldosterone (RAA) system by reducing sodium reabsorption and facilitating renal excretion. Sodium balance in the kidneys is maintained by increased excretion of sodium with age, which leads to an increase in atrial natriuretic peptide and consequently to an increase in blood pressure. As kidney function declines over time, the RAA system weakens leading to sodium and fluid retention and increased vascular resistance [17]. Blood sodium concentration also plays an important role.

An increase in salt intake leads to an increase in the concentration of sodium in the blood, which causes a change in osmotic pressure and the transfer of fluid from the intracellular to the extracellular space. Also, the gradual increase in blood pressure is introduced by the increased concentration of sodium in the blood, which leads to the secretion of vasopressin, which causes fluid retention (Figure 1) [18].

However, during the reduction of salt in the diet in hypertensive patients there is always a drop in blood pressure, it is concluded that there are people who are salt sensitive or salt resistant, which is related to the following factors: gender, age, ethnicity, genetics and
comorbidities [19,20]. The public health problem is the incidence of sensitive people with hypertension is 51%, while it is 26% among people with normal blood pressure [21].

The recommended method for diagnosing salt sensitivity involves exposure to a one-week high-salt diet, followed by a one-week phase of a low-salt diet, which is followed by blood pressure measurement. If the increase in blood pressure is equal to or greater than 3-5 mmHg, the person is considered a normotensive person who is sensitive to salt. If the change in blood pressure is below 3-5 mmHg, the person is considered salt resistant. If the change in blood pressure is equal to or greater than 8-10 mmHg, the person is classified as salt-sensitive hypertensive [22].

**DIETARY SALT INTAKE**

Dietary salt intake includes: intake from industrial/processed food (70-75%), sodium naturally contained in raw foods (10-15%) and discretionary addition of salt during food preparation and consumption (10-15%) [23]. Research has shown that the highest intake of salt is through bread and cereal products, meat and meat products, cheese and other dairy products [23]. The research conducted in the Republic of Srpska based on the analysis of the salt content in white bread using the Mohr method, provides data that the salt content is varied and ranges from 1.1 to 2.4 g of salt per 100 g of white bread [24]. Research conducted in Novi Sad, which included bread made from several types of flour (white, whole wheat, rye, mixed) gave the result that the average value of salt per 100 g of bread ranged from 0.75 to 1.91 g [25]. The analysis of 1069 ready-to-eat food samples (various types of ready to eat cereal, pizza, hamburgers, sandwiches) in the territory of Novi Sad showed that the concentration of salt per 100 g of food was from 0.36±0.48 g in ready-to-eat cereal to 2.32±1.02 g in grilled meat [26].

**REDUCTION OF SALT INTAKE AS THE FIRST STEP IN HYPERTENSION THERAPY**

Daily salt intake ranges from 5.39 g to 18.51 g for men and from 4.27 g to 16.14 g for women, according to a systematic review and meta-analysis of the WHO salt intake data for the European Region [27]. The daily population intake of salt in 46 European countries is greater than 7.5 g, while in 23 countries the population intake of salt is above 10 g, which is 50% or 100% higher than the WHO and EFSA recommendations [27]. Consuming a large amount of salt is considered a cause of hypertension, and hypertension is a risk factor for cardiovascular events such as myocardial infarction, stroke, and other heart diseases [28]. Models based on salt intake calculations estimate 3 million deaths and 70 million DALYs globally related to increased salt intake [4]. The World Health Organization considers the reduction of salt intake as the gold standard in the prevention of cardiovascular events and in achieving the goals of reducing premature deaths from fatty non-communicable diseases [29]. A dose-dependent relationship between salt intake and blood pressure/cardiovascular diseases has been established [30]. It was established that by reducing salt intake, both systolic and diastolic blood pressure is lowered, regardless of gender, age and ethnic group, in hypertensive or normotensive subjects [31]. Also, a greater drop in systolic blood pressure was indicated with greater reductions in salt intake, compared to a drop in diastolic blood pressure [32].

The Dietary Approach to Stop Hypertension (DASH) represents a specific way of eating, rich in fruits, vegetables, whole grains, vegetable oils, fish, and low in red meat and meat products, saturated fats, simple sugars and salt [12]. The conclusion of the research with the DASH diet and salt reduction (3 groups of respondents with consumption of 8/6/4 g of salt) is that the respondents with the lowest daily salt intake had the greatest reduction in blood pressure [12,33].

The conclusion that the greatest success in lowering blood pressure is the synergistic effect of salt and body weight reduction was derived from a randomized controlled trial with the aim of testing nonpharmacological interventions in the elderly (Trial Of Nonpharmacological Interventions in Elderly, TONE) [34].

Hypertension as a comorbidity among patients with diabetes is one of the main risk factors for the occurrence of cardiovascular events as well as vascular changes [35,36,37]. Meta-analysis of clinical trials on the effect of a low-salt diet on blood pressure in diabetics indicated a reduction in both systolic and diastolic pressure [38].

**GLOBAL ACTIONS AIMED TO REDUCE POPULATION SALT INTAKE**

The largest part of daily salt intake is related to the consumption of industrially processed foods, from 70 to 75%, which also refers to the consumption of bread and cereal products and fast food [39]. Risk factors for the occurrence of CVD can be divided into immutable (genetics, gender and age) and variable (social, biological and behavioral factors). Salt intake is a segment of a proper diet and is considered one of the modifiable risk factors [40]. However, as stated, apart from changes in eating habits regarding the choice of food, activities aimed at the makers of legal regulations and food producers are necessary. Namely, bread is a basic food whose composition is regulated by regulations in that area, but the salt parameter is not mandatory in accordance with the regulations and there are no ref-
The experiences from Great Britain are positive in population reduction of salt consumption. Namely, the first step was the formation of a working group for the population reduction of salt, followed by a cross-sectional study that determined the population’s salt intake. The next step involved setting goals for salt reduction in certain food groups together with food manufacturers with continuous monitoring. At the same time, public health campaigns to raise awareness about the harmful effects of salt on health followed. The joint result of these activities was a population reduction of salt by 20% to 50% for a period of 10 years with a consequent reduction in the incidence of hypertension and CVD [11]. Great Britain continues monitoring the declared salt content and for the period from 2015 to 2020, a decrease in the declared salt content was observed, especially in ready-to-eat cereals (-16%), followed by processed vegetables (-10.6%) and meat / seafood (-9.2%) [41].

Today, almost every EU country has different strategies that include recommending salt reduction through food reformulation to reduce the salt content of food, including bakery products. For example, various programs are being developed in the EU to promote salt reduction, such as “STOP SALT!” in Hungary, “Acquiring healthy habits: making healthier choices easier” in Italy which specifically encourages the reduction of salt in bread and the National Food and Nutrition Action Plan 2012-2017 in Bulgaria. Strategies for the reformulation of bakery products with regard to salt reduction continue in the EU countries: in Austria, a reduction of salt of 15% by 2015 has been established by the Federal Ministry of Health, in Italy of 10% by 2012 by the Ministry of Health, in Spain from 20% by 2014 by the Ministry of Health and Social Policy, in Hungary the bakery association recommended a reduction of salt in bread after December 2018 to a maximum level of 2.35 vol% [42].

EU Regulation No. 1169/2011 regarding customer information requires the mandatory declaration of salt per 100 g or 100 ml, instead of the previous declaration, which misleads the customer.

CONCLUSION

The reduction in salt intake could contribute to the reduction in the incidence of hypertension and a consequent reduction in cardiovascular events. By reducing the incidence of disease, the costs intended for the treatment of diseases that are considered preventable are reduced, especially the reduction of salt intake, which has absolutely no material costs for an individual. Considering the existence of models by which countries in the region have succeeded in reducing the population’s intake of salt, it is necessary to activate all actors for the implementation of the model from the surrounding EU countries, in order to take the first steps in reducing salt in processed food, with special reference to bakery products and reached the population intake in accordance with the WHO recommendation, i.e. 5 g of salt per day. Achieving and maintaining the reduction of the population’s salt intake, even in small amounts and in any way, will soon give a great benefit in terms of the prevention of cardiovascular events as the first cause of death in the world, then great savings for the health system and an individual.

REFERENCES


Smanjenje unosa soli kao prvi korak u prevenciji hipertenzije

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Kratak sadržaj
Pre više miliona godina, čovek je konzumirao soli isključivo hranom, što je iznosilo manje od 0,5 g/dan. Novija istraživanja su ukazala da prosečna dnevna konzumacija soli iznosi više od 10 g/dan. Glavni zaključak studija koje su se bavile istraživanjem povezanosti između unosa soli i krvnog pritiska su vodile ka formiranju preporuka o smanjenju unosa soli od strane Svetske zdravstvene organizacije i Evropske agencije za sigurnost hrane i ograničavanju dnevnog unosa soli na 5 g. Povećani unos soli izaziva supresiju Renin-Angiotenzin-Aldosteron sistema smanjenjem bubrežne ekscercije natrijuma. Takođe, povećan unos soli izaziva promenu osmotskog pritiska, povećano lučenje vazopresina i povećanje krvnog pritiska. Hleb kao osnovna namirnica je sa visokim sadržajem soli, ali ne postoji regulativa koja reguliše količinu soli. Danas, skoro svaka zemlja članica Evropske Unije razvija strategije koje uključuju smanjenje unosa soli putem formulacije hrane sa posebnim osvrtom na hleb i pekarske proizvode. Postizanje i održavanje populacionog unosa soli bi uskoro dali rezultate u pogledu prevencije kardiovaskularnih događaja kao prvog uzroka smrti globalno, uštedu zdravstvenom sistemu, kao i bolesniku.

Ključne reči: So; redukcija; hipertenzija; kardiovaskularne bolesti; prevencija.