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Sodium intake and dietary sources of sodium in a sample of undergraduate students from Novi Sad, Serbia

Unos natrijuma i nutritivni izvori natrijuma u uzorku studenata iz Novog Sada, Srbija

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Abstract

Background/Aim. Data on sodium intake and sources of sodium in the diet in Serbia are limited. The aim of this study was to estimate the sodium intake and identify the sources of sodium in the diet of undergraduate students attending the University of Novi Sad. **Methods.** Students completed a questionnaire to gather data on their gender, age and university faculty attended, and then a 24 h dietary recall. The sodium intake of the students was calculated using the dietary recall data and data on the sodium content of foods. The contribution of different food groups as well as of specific foodstuffs to the total sodium intake was calculated. **Results.** The mean estimated sodium intake of the students was 3,938.5 ± 1,708.1 mg/day. The sodium intake of 89.1% of the surveyed students exceeded the guideline for sodium intake, the majority of the sodium coming from processed foods (78.9% of the total sodium intake). The food groups that contributed the most to the total sodium intake of the students were meat and meat products (21.7%) and cereals and cereal-based products (18.6%). Bread and other bakery products were responsible for 13.1% of the total sodium intake. **Conclusion.** High sodium intake in students of the University of Novi Sad puts them at high risk of developing high blood pressure. The food industry should work towards reformulating products with high sodium content, especially bread and other bakery products. Efforts should be taken to reduce sodium intake among undergraduate students in Novi Sad.

Key words:
sodium, dietary; risk factors; students; serbia; food habits.

Apstrakt

Uvod/Cilj. Podaci o unosu natrijuma i izvorima natrijuma u ishrani stanovništva Srbije su ograničeni. Cilj ovog istraživanja bio je da se proceni unos natrijuma i da se identifikuju izvori natrijuma zastupljeni u ishrani studenata Univerziteta u Novom Sadu. **Metode.** Studenti su popunili upitnik kojim su prikupljeni opšti podaci (pol, uzrast, pohađani fakultet), a potom i anketu ishrane po sećanju za 24 časa. Unos natrijuma izračunat je na osnovu podataka iz ankete ishrane i podataka o sadržaju natrijuma u konzumiranim namirnicama. Izračunat je i doprinos različitih grupa namirnica, kao i doprinos pojedinih namirnica ukupnom unosu natrijuma. **Rezultati.** Prosečni procenjeni unos natrijuma među studentima bio je 3 938,5 ± 1 708,1 mg/danu. Od ukupnog broja, 89,1% ispitanika unosilo je više natrijuma od preporučene količine. Natrijum u ishrani studenata u najvećem procentu poticao je iz industrijski prerađenih namirnica (78,9% ukupnog unosa natrijuma). Grupe namirnica koje najviše doprinose ukupnom unosu natrijuma među studentima bile su meso i proizvodi od mesa (21,7%) i žitarice i proizvodi od žitarica (18,6%). Hleb i drugi pekarski proizvodi bili su odgovorni za 13,1% ukupnog unosa natrijuma. **Zaključak.** Visok unos natrijuma među studentima Univerziteta u Novom Sadu predstavlja faktor rizika od razvoja hipertenzije. Industrijski prerađene namirnice sa visokim sadržajem natrijuma, poput hleba i drugih pekarskih proizvoda, trebalo bi reformulisati. Potrebno je sprovesti obrazovne i promotivne aktivnosti kako bi se unos natrijuma u studentskoj populaciji Univerziteta u Novom Sadu smanjio.

Ključne reči:
natrijum, unos hranom; faktori rizika; studenti; srbija; ishrana, navike.

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Introduction

Hypertension is the leading cause of death worldwide, responsible for 13% of global deaths and close to 4% of disability-adjusted life years [1]. Globally, 40% of adults aged over 25 suffered from high blood pressure in 2008 [2].

High sodium intake causes blood pressure elevation and is a proven modifiable risk factor for hypertension [3]. The World Health Organization (WHO) considers the reduction of sodium intake to be one of the ten "best buy" (cheap, feasible and cost-effective) interventions in reversing the global epidemic of noncommunicable diseases [2]. The current WHO guideline for sodium intake is 2,000 mg/day (5 g of salt *per* day) [4], but the mean sodium intake varies by country and is almost always above the guideline amount [5,6]. Most of the sodium in the "Western diet" comes from processed foods (75%), while only around 10% comes from sodium added to food during cooking or at the table [6–8].

Serbia, as many developing countries, is currently facing an ongoing nutrition transition and a growing burden of noncommunicable diseases. The estimated prevalence of hypertension among adults in Serbia is 46.5% [9]. In the Autonomous Province of Vojvodina, the northernmost part of Serbia, the prevalence of hypertension among adults aged 45 and older is estimated to be 65.5% and in Novi Sad, the regional capital, the prevalence is as high as 70% [10]. Data on sodium intake and sources of sodium in the diet are limited, labeling of salt content in retail food is not required by national legislation and, to date, no activities have been undertaken to raise awareness or reduce sodium intake on the national level.

The aim of this study was to estimate the sodium intake and identify the sources of sodium in the diet of undergraduate students from Novi Sad.

Methods

For this cross-sectional study data were collected during the 2011/12 academic year. Students attending the University of Novi Sad were eligible to participate in the study and there were no exclusion criteria. The students were informed that their participation in the study was voluntary. The response rate was 94% (17 of the students refused to participate in the study).

The Ethical Committee of the University of Novi Sad ruled that specific approval or signed consent from the participants was not required. The management of the University of Novi Sad gave permission for the study to be conducted.

The students completed a questionnaire to give data on their gender, age and faculty attended, and then on a 24-hour dietary recall (24 h DR) in written form. The students were asked by a trained interviewer to write down all the foods and beverages they had consumed during the previous day (24 h), as well as the amounts where possible. After that, the interviewer prompted the students to remember the foods and beverages usually not reported during the 24 h DR (beverages, sweets, salty snacks, fruits, vegetables, bread and cheese) [11]. Where applicable, the amounts of foods and beverages consumed were estimated using a portion size photo album [12] shown to the participants by the interviewer.

The data on the sodium content of foods and beverages consumed by the participants were obtained from the national food composition database [13] and from the regional food composition databases [14, 15], in cases where specific national data were not available.

An application specially designed for the purpose of this study was used to calculate sodium intake using the data on the sodium content of foods and beverages from the food composition databases and the data from the 24 h DR. Sodium intake (mg/day) was calculated for each participant as a sum of the products of the amount of consumed food or beverage and the sodium content of that specific food or beverage. The discretionary sodium intake was not included in the final estimate of sodium intake.

The aforementioned application allowed for the foods and beverages consumed to be categorized using various descriptors (categorizations). The consumed foods and beverages were divided into the following groups: cereals and cereal-based products, meat and meat products, dairy foods, composite meals, fruits, vegetables and fruit-based and vegetable-based products, sweets, salty snacks, beverages and miscellaneous. Foods and beverages were also categorized into processed foods, composite meals or foods and beverages with natural sodium content (no added sodium). The contribution of each group as well as of specific foodstuffs to the total sodium intake was calculated.

Statistical analysis was performed using the IBM SPSS Statistics version 20.0 (IBM Corporation, 2011). The data were reported as counts and percentages or the mean value ± standard deviation (SD) where applicable. The categorical data were compared using the χ^2-test. The differences between numerical data were assessed using Student's *t*-test.

P values of < 0.05 were considered statistically significant.

Results

A convenience sample of 266 students (mean age 21.26 ± 1.97 years, 45.1% males) both in medical and in non-medical studies participated in the study and completed the 24 h DR. Sample characteristics are shown in Table 1.

Table 1

Sample characteristics (n = 266)

Characteristics	Values
Age (years), $\bar{x}$ ± SD	21.26 ± 1.97
Gender, n (%)	
males	120 (45.1)
females	146 (54.9)
Study program type, n (%)	
medical	42 (15.8)
non-medical	224 (84.2)

$\bar{x}$-mean; SD – standard deviation; n – number of students.

The mean estimated sodium intake of the students was 3,938.5 ± 1,708.1 mg/day (equal to 9.8 ± 4.3 g/day of sodium chloride/salt) (Table 2). The sodium intake of female participants was significantly lower than the sodium intake of male participants ($p < 0.001$). The medical students consu-

Table 2
Mean estimated sodium intake (mg/day) of the students attending the University of Novi Sad (n = 266)

Students	Sodium intake mean ± SD	*t*-value; *p* value
Total sample	3,938.5 ± 1,708.1	
Gender		
males	4,726.5 ± 1,835.1	$t = 7{,}247$; $p < 0.001$
females	3,290.9 ± 1,277.8	
Study program type		
medical	3,029.1 ± 1,035.2	$t = 5{,}449$; $p < 0.001$
non-medical	4,019.1 ± 1,756.5	

SD – standard deviation.

med less sodium *per* day than non-medical students ($p < 0.001$) (Table 2).

The sodium intake of 89.1% of the surveyed students exceeded the WHO guideline for sodium intake. The percentage of male participants consuming more than 2,000 mg of sodium *per* day was higher than the corresponding percentage of female students (95.0% and 84.2%, respectively) ($\chi^2 = 7.841$; $p = 0.005$). There was no statistical difference between the percentage of medical students (83.3%) and the percentage of non-medical students (90.2%) whose sodium intake was above the guideline amount ($\chi^2 = 1.706$; $p = 0.19$).

The food groups that contributed the most to the total sodium intake of the students were meat and meat products (21.7%) and cereals and cereal-based products (18.6%), followed by composite meals (17.0%). The "miscellaneous" category was responsible for 28.7% of the total sodium intake. The contribution of specific food groups to the total sodium intake among the participants is shown in Figures 1, 2 and 3 (total, by gender and by study program type).

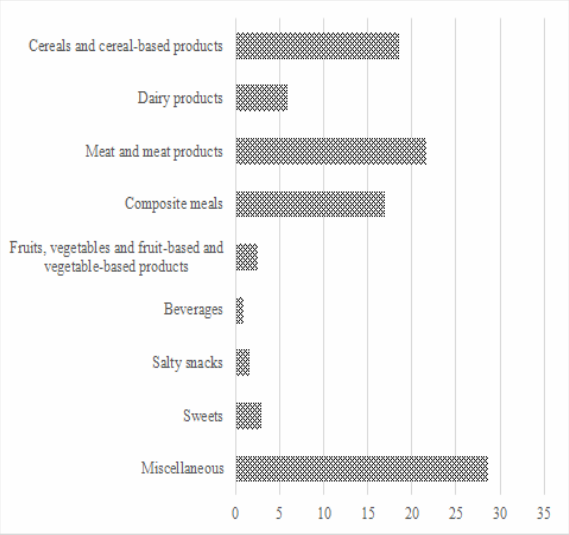

Fig. 1 − The contribution of different food groups to the total sodium intake of students attending the University of Novi Sad (n = 266).

The major dietary sources of sodium among males and females were similar. Males consumed more sodium *via* meat and meat products than females. The non-medical students consumed 17.2% of their total sodium intake through composite meals as opposed to medical students

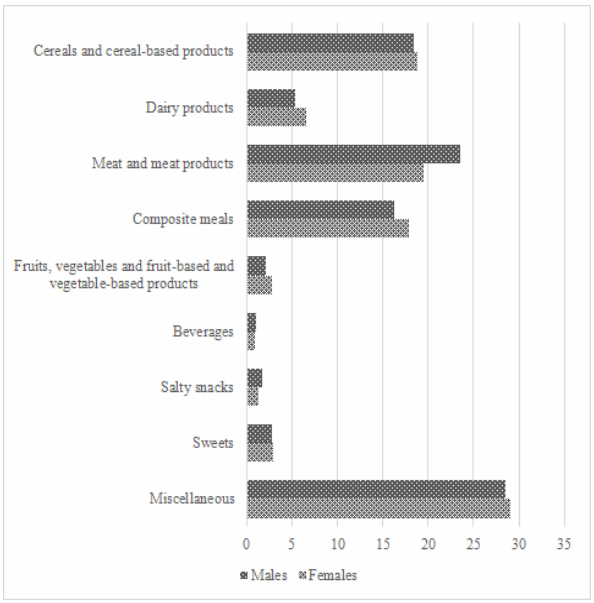

Fig. 2 − The contribution of different food groups to the total sodium intake of the students attending the University of Novi Sad by gender (n = 266).

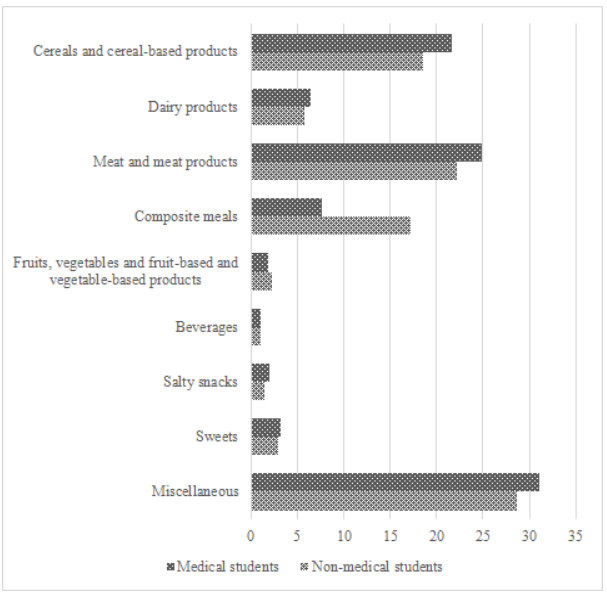

Fig. 3 − The contribution of different food groups to the total sodium intake of the students attending the University of Novi Sad by the study program type (n = 266).

who consumed 7.6% of their total sodium intake by way of composite meals.

The majority of the consumed sodium was from the processed foods (78.9% of the total sodium intake), regardless of the gender and the faculty attended.

Sodium was mostly consumed *via* bread and other bakery products (13.1% of the total sodium intake) and cured meat products (5.1%). Bread alone contributed 9.7% to the total sodium intake or an average of 682.7 mg of sodium/day/person. Almost half of the sodium consumed (49.2%) was from a narrow selection of foods including bread and other bakery products, cured meat products, "fast foods", salty soups, cheeses, sauces and gravies (Table 3).

Table 3

The contribution of specific foods to the total sodium intake of the students attending the University of Novi Sad (n = 266)

Food groups	Contribution of specific foods to the total sodium intake	
	mg sodium/day/person	% of total sodium intake
Bread and other bakery products	746.6	13.1
Cured meat products	1,066.7	8.1
Fast foods (pizza slices, sandwiches, traditionally prepared cheese pastries, traditionally prepared minced meat patties)	1,487.8	14.3
Commercial soups	1,209.7	9.8
Cheese	474.5	2.7
Sauces and gravies (incl. ketchup and mayonnaise)	350.0	1.2
Total		49.2

Discussion

The data presented in this study are the first data on sodium intake of the population of students in Serbia. Undergraduate students were chosen as a sample because they are healthy young adults, as yet unaffected by hypertension or other noncommunicable diseases and among whom risk reduction strategies potentially give better and longer lasting results than among older or hypertensive people.

We found a high sodium intake in the students of the University of Novi Sad (3,938.5 mg/day on the average), that puts them at high risk of developing high blood pressure. The data on sodium intake of the students do not include discretionary sodium added at the table or during cooking and therefore the total sodium intake is most probably underestimated. Discretionary sodium intake usually accounts for 10−15% of the total sodium intake [7, 8, 16]. Nevertheless, the majority of the undergraduate students surveyed in Novi Sad consume more than 2,000 mg of sodium *per* day. The mean estimated sodium intake of the participants is almost double the guideline amount.

Although high, sodium intake of our participants is similar to the reported sodium intakes of other population groups. According to Brinsden and Farrand [5], the average sodium intake worldwide ranges from 2,000−7,200 mg of sodium/day (5 g to 18 g of salt/day). These findings are supported by many authors from different countries [17–24]. The reported sodium intake of people above 2 years of age in the United States (US) is 3,266 mg/day (excluding discretionary sodium intake) [17]. Data from the European Union suggest that sodium intake is in excess of 2,000 mg/day in most European countries [18]. Sodium intake in the general population of Slovenia and Croatia is around 4,500 mg/day [19, 20], while sodium intake in Bulgaria and Hungary is on the average 6,500 mg/day. Sodium intake of our students is lower than the reported sodium intakes in the region probably due to the underestimation of sodium intake in our study, existing differences in the characteristics of the surveyed population groups and possibly due to different methodologies applied.

The female students from our study consume less sodium than males (3,290.9 mg/day and 4,726.5 mg/day, respectively), which is similar to the findings of other authors [6, 18–22, 24, 26, 27]. Gender differences in sodium intake are explained by higher overall food consumption (higher energy intake) among men [6, 26]. Medical students consume less sodium than non-medical students in part due to gender differences – there were more females in the medical students group in comparison to the non-medical students group. Medical students are expected to have better nutrition-related knowledge than non-medical students, which may also be associated with lower sodium intake. One study reported that a daily meal in students dining halls in Novi Sad contained 6,400−7,200 mg of sodium (results from 2008) [28]. The location of students dining halls in Novi Sad, close to the main campus, is inconvenient for medical students (the Faculty of Medicine is the only faculty not located within campus grounds and is considerably for from students dining halls), so the proportion of medical students usually eating in them is not as high as the proportion of non-medical students doing so. This should also be taken into account when comparing sodium intake of medical and non-medical students.

A high sodium content of processed foods is the main reason for excessive sodium intake in the developed "Western" societies [7, 8, 26]. Studies show that up to 77% of sodium consumed in the US [25] and up to 85% of sodium consumed in the United Kingdom is from processed foods [8]. A small proportion of dietary sodium is naturally contained in foods, while the rest of sodium in the diet is added to food during cooking or at the table [8, 26]. Similarly, our results show that 78.9% of the total sodium intake (excluding discretionary sodium intake) of the students from Novi Sad is attributable to processed food consumption. The described results are expected because nutrition transitions are chan-

ging the traditional diets of developing countries, including Serbia, shifting them to diets of cheaper, processed foods, high in saturated fats, added sugars and sodium (added as salt) [29].

Food categories usually contributing the most to the total sodium intake in the US and the European Union are bread, other bakery and cured meat products. Americans consume 7.4% of their sodium through bread and other bakery products and 5.1% of their sodium *via* cured meat products [17], while in Europe percentages vary between countries. In the region, bread and other bakery products were identified as the main source of sodium in the diet of Bulgarians, responsible for 40−50% of the total sodium intake [30]. Bread, bakery products and meat products are also the main sources of sodium in Hungary [30]. Our results show that students consume most of their sodium *via* meat and meat products and cereals and cereal-based products. As in other countries [17, 30, 31], bread and other bakery products (13.1%) and cured meats (5.1%) are significant contributors to the total sodium intake.

It has been reported that in the US, 10 food categories are accountable for 44% of the total sodium intake. We also found that a limited number of food categories (bread and bakery products, cured meat products, "fast foods", salty soups, cheeses, sauces and gravies) are responsible for almost half of the total sodium intake, making it essential that future reformulation efforts on the part of the food industry focus on these food categories. Although the students from our sample consume most of their sodium from foods categorized as "miscellaneous" (28.7%), foods from this group should not be viewed as target foods for sodium reduction efforts (reformulation) due to their diverse nature.

The limitations of this study are: estimation of sodium intake using 24 h DR which may result in underestimation of the total sodium intake (underreporting of the amounts of the foods or not reporting the use of specific foods); exclusion of discretionary sodium intake from the final estimation of the total sodium intake, and the specific (narrow) population group on which the study was conducted, making it hard to extrapolate the results to the general population. Nevertheless, as some of the first data on sodium intake available in Serbia, the results of this study show the need for a more detailed assessment of sodium intake and the sources of sodium in the diet of the Serbian population.

Reduction of salt intake is a complex task and requires the simultaneous involvement of all stakeholders, including government, non-governmental organizations, mass-media, food industry, mass catering industry and consumers [18, 32]. Salt reduction efforts have been reported in some countries in the region, including Slovenia, Hungary, Bulgaria [33] and Croatia [34]. Although the national program for the prevention, medical treatment and control of cardiovascular diseases in Serbia until 2020 ("Healthy Heart for All") [35] mentions a reduction in salt intake in the population as a whole, to date no action has been taken to actively address this issue.

Conclusion

Considering the growing burden presented by hypertension and cardiovascular diseases in Serbia, cost-effective strategies for hypertension and cardiovascular risk reduction, such as sodium intake reduction, should be embraced and actively practiced by policy makers and stakeholders. The labeling of salt content in retail foods should be made obligatory. Food industry should work on reformulating products with high sodium content, primarily bread and bakery products and meat and meat products. Undergraduate students as well as the general population should be empowered to make better dietary and lifestyle choices through education about the health consequences of high sodium intake.

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